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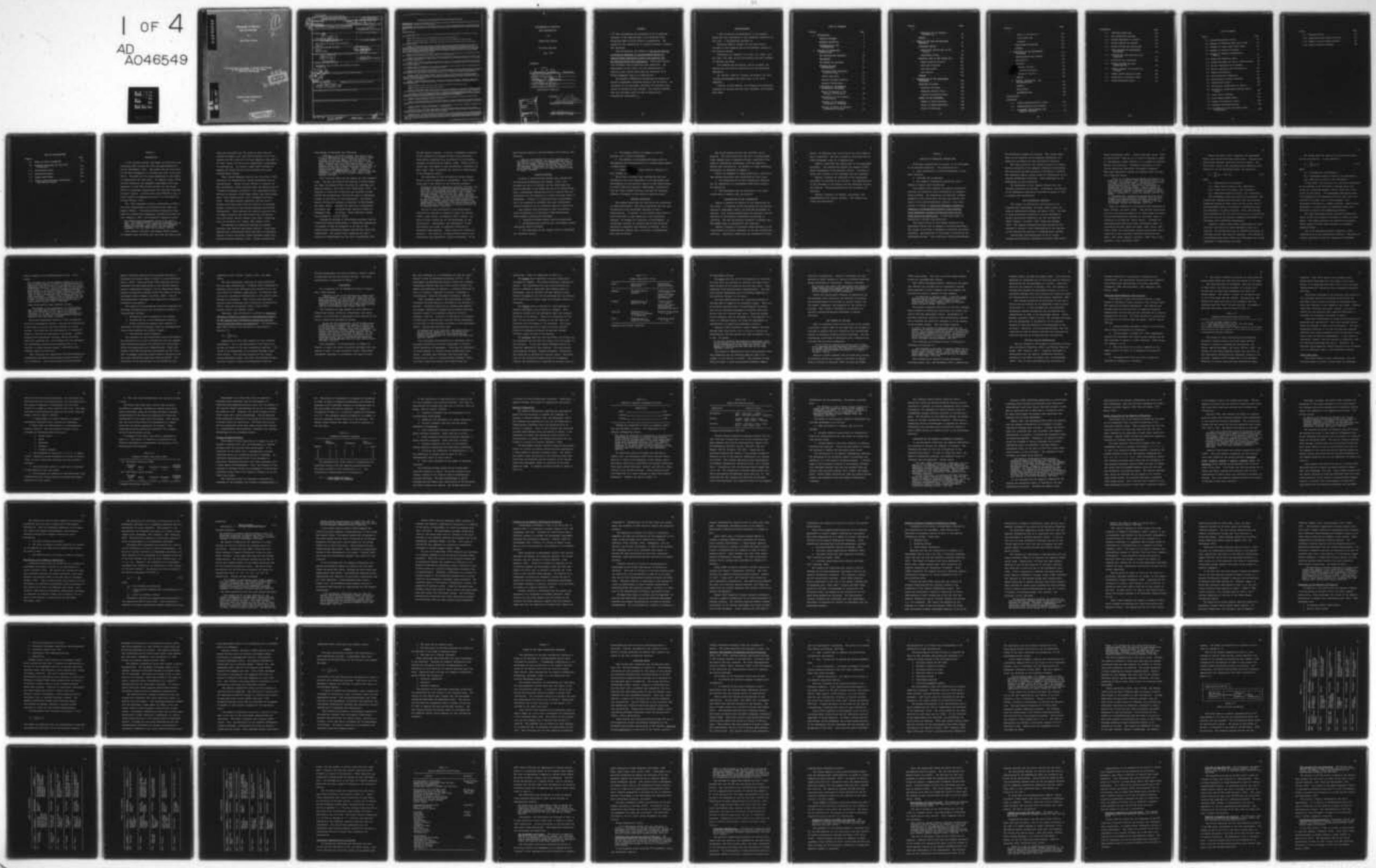

MEASUREMENT OF COMPUTER
USER SATISFACTION

by

Sammy Wray Pearson

A Dissertation Presented in Partial Fulfillment
of the Requirements for the Degree
Doctor of Philosophy

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MEASUREMENT OF COMPUTER

USER SATISFACTION

by

Sammy Wray Pearson

has been approved

July, 1977

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ABSTRACT

User satisfaction was considered to be an important indicator of the effectiveness of the Electronic Data Processing (EDP) activity within an organization. The purpose of this research was to develop the means to measure this indicator.

User satisfaction was defined as the sum of feelings or affective responses to distinguishable factors of computer-based information products and services that are provided within the organization. Thirty-nine factors that influence user satisfaction were identified. The completeness of this factor set was substantiated by empirical test results based upon the interviews of 32 middle management users in 8 organizations.

The semantic differential methodology was adapted to develop a measurment instrument based on the 39 factors. An evaluation of the instrument confirmed the necessary properties of reliability and validity. The results indicated that the instrument could be used to measure user satisfaction successfully.

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Chapter 1

INTRODUCTION

In the national economy, the budget for Electronic Data Processing (EDP) services for 1974 was approximately $28 billion (McLaughlin, 1974). The growth rate for this activity has been averaging 8 to 10 percent per year in the early 1970's. The effect of this large expenditure on the affected organizations has been mixed. For example, Staats (1973) credited automation and management improvements with wage reductions of over $200 million annually for the period 1967-72 in government organizations that maintain individual citizens' records. A private firm saved $750,000 a year in "hard" dollars by changing from batch to on-line data processing (Rickert, 1975).

Yet, these apparently positive contributions of EDP to the parent organizations were contradicted by reports of negative effects. The Aeroject-General Corporation eliminated all computer-based management information systems for their company in 1969. The President of Aeroject stated:

> The computer-based management system is not worth a damn... By eliminating the system we eliminated a lot of money from overhead: more importantly our management capability improved dramatically. We have better management at a lot lower cost (Constant, 1973:2).

Peat, Marwick, Mitchell, and Company (1976) surveyed 147 computer users and found that less than one third of the

users were satisfied with the return on their data processing investment; yet, more than 90 percent of the users expected the EDP resources to be more important than ever in the next 5 years in terms of the organization's performance or profitability. In contrast, Adams (1975) surveyed 75 managers and found that most were satisfied with their computer-based systems.

These limited examples indicate that the effect of EDP services on an organization's overall performance was not unidirectional. Current and past efforts to evaluate the EDP contribution, usually reported under the nomenclature of "computer performance evaluation", have concentrated almost entirely on measures of efficiency rather than effectiveness (Bell, 1971; Hughes and Moe, 1973; Hellerman and Conroy, 1975). Efficiency measures generally take the form of hardware utilization data with the objective of attaining greater utilization of the existing hardware and software configuration. These measures are usually statistics such as central processor unit (CPU) direct-time utilization, core utilization, percent channel "busy time", turnaround time, mix profiles, etc. (Boehm, 1970; Watson, 1971).

The dominance of efficiency measures has created pressures that have had some adverse effects. Since these measures have traditionally formed the basis of evaluation, efforts to drive utilization toward saturation levels have naturally evolved (Constant, 1973). McLean clarified the

shortcomings of measuring only efficiency:

> Efficiency, as defined through long usage in the field of engineering, is a measure of a unit of output in terms of a unit of input. More particularly, in computing it has been defined as "the ratio of time spent on useful work to total power-on time". In this sense, "useful work" means the time during which the computer is not idle or used for reruns, maintenance, or other non-productive activity. Whether in fact this computer work is <u>really</u> useful - from a managerial standpoint - is quite another matter. This is much more difficult to judge but is a far more critical issue (McLean, 1973:95).

This "critical issue" was the impetus for this research study. The need for quantitative measures of effectiveness was often articulated without direction for achieving such measures (Argyris, 1971; Ward, 1973; MacWilliams, 1975). An exception to this lack of direction was provided by Lucas (1973b) who hypothesized a descriptive model of information systems in the context of the organization. He proposed several variables of interest as measures of effectiveness. His model, howeve suffered the same lack of measurement instruments that racterized other empirical studies of management infor .on systems. These additional studies were reviewed by an Horn (1973).

Although the problem of effectiveness measures could be viewed from several perspectives, it seemed most appropriate to consider it from the viewpoint of the user of the computer-based information products and services within the organization. One variable that integrated the user's criteria of effectiveness was the user's satisfaction with

the EDP support rendered. A series of management workshops on EDP productivity conducted at Ohio State University consistently identified user satisfaction as the foremost indicator of effectiveness (Morris, 1976). Holmes (1970:32) stated that "the degree of user satisfaction is probably the most useful index of measuring the success or effectiveness of an information system".

The importance of user satisfaction carries beyond merely a state of happiness or unhappiness. Lucas summarized some of the effects in the following statement:

> Information services department practices influence user attitudes. Poor attitudes will reduce cooperation; users will not encourage the design of new systems and will tend to sabotage existing ones. Due to badly designed systems, little or no user input, and poor attitudes, systems will not be used unless mandatory ... information systems will have little or no influence on user performance. In this situation information systems have failed because their contribution to the organization is nonexistent or far below success given these conditions, and a cycle of continued failure can be expected (Lucas, 1973b:35).

The use of user satisfaction as an effectiveness indicator was reported in studies by Powers and Dickson (1973), Lucas (1973a), and Swanson (1974); however, the focus of these studies was not the measurement of user satisfaction. Consequently, the "measurement" of user satisfaction was either by subjective interviews or incomplete questionnaires. These studies are reviewed in Chapter 3. The inability to quantitatively measure user satisfaction was regarded as a major shortcoming. As the

great British physicist, William Thompson (Lord Kelvin) once observed:

> When you can measure what you are speaking about, and express it in numbers, you know something about it; but when you cannot express it in numbers, your knowledge is of a meager and unsatisfactory kind; it may be the beginning of knowledge, but you have scarcely, in your thoughts, advanced to the stage of science (cited by Wagner, 1976:86).

PROBLEM STATEMENT

In order to quantitatively measure user satisfaction, the following developments were needed. First, user satisfaction had to be defined, and the underlying propositions embodied in the definition had to be substantiated. Then, a measurement methodology had to be devised that was compatible with the definition to create the actual means of measurement. Finally, the resultant means of measurement had to be evaluated to establish that user satisfaction could be measured with an acceptable degree of reliability.

Many benefits were envisioned if user satisfaction could be measured as an indicator of EDP effectiveness. These benefits included the following:

1. Standards of effectiveness could be established.
2. Performance goals could be set, and progress toward those goals could be tracked.
3. The weak areas of user support could be identified for corrective action.

4. The marginal effects of changes in service, policies, etc. could be determined.

5. The emphasis on increasing efficiency could be complemented and counterbalanced by a corresponding emphasis on effectiveness.

6. Differe[illegible]vities could be compared on a more complete basi[illegible]

The ability to measure user satisfaction was also considered to be a key requirement in the development and investigation of the theoretic aspects of EDP effectiveness. As Ackoff (1962:216) observed, "Measurement, perhaps more than any other research activity, has been the principal stimulus of progress in both pure and applied science."

RESEARCH OBJECTIVES

The research objectives for this study were predicated on three propositions. The first proposition was that user satisfaction is an attitudinal construct of multi-dimensionality. A construct is an attribute that exists in every individual to some degree but is not physically tangible. An example of a construct is intelligence. An attitudinal construct is characterized by both direction (positive or negative) and intensity of feeling. Multi-dimensionality implies that a construct is influenced by more than one factor.

The second proposition was that attitudes can be measured. The third proposition was that a scaling methodology commonly used to measure attitudes, specifically the semantic differential methodology, could be adapted to measure user satisfaction. An analysis of these underlying propositions is presented in Chapter 2.

Within the framework of these propositions, the following research objectives were established for this study:

1. The definition of the user satisfaction construct and the formulation of a measurement model which reflects the definition.

2. The development and the evaluation of the operational means to measure user satisfaction.

ORGANIZATION OF THE DISSERTATION

Chapter 2 presents an analysis of the propositions of this study. A literature review concerning the satisfaction construct, measurement theory, and attitude measurement is reported. Four scaling methodologies are evaluated, and the selection of the semantic differential methodology is justified. The user satisfaction construct is defined and a measurement model is proposed for the construct.

Chapter 3 presents a literature review pertinent to the identification of factors important to the user satisfaction construct. Operational definitions are formulated for each

factor. An empirical test of the factor list for completeness is described. The test is based on interviews with 32 middle management users in 8 organizations.

Chapter 4 describes the construction of the measurement instrument. The construction applies the semantic differential methodology to the construct factors. Decisions of format and a pretest of the instrument are also addressed.

Chapter 5 presents an evaluation of the measurement instrument for reliability and validity. The administration of the instrument to 29 subjects and the subsequent analysis are reported. Scoring procedures for the instrument are described.

Chapter 6 presents the summary, conclusions, and recommendations for further research. This chapter concludes the dissertation.

Chapter 2

ANALYSIS OF UNDERLYING PROPOSITIONS

Three major propositions are central to the achievement of the research objectives. The propositions are:

1. User satisfaction is a multi-dimentional, attitudinal construct.

2. Attitudes can be measured.

3. The semantic differential methodology can be adapted to measure user satisfaction.

This chapter first examines the general satisfaction construct as studied by other investigators in organizational settings. The theoretical and empirical evidence examined in this review shows the user satisfaction construct to be a multi-dimensional attitude. User satisfaction is defined as <u>the sum of feelings or affective responses to distinguishable factors of the computer-based information products and services that are provided within the organization</u>. A measurement model is formulated to reflect this definition.

The second portion of this chapter centers on the measurement theory that is germane to attitude measurement. The concept of attitude is examined to establish the nature, components, and properties of the concept to facilitate the measurement process. Four traditional scaling methodologies

for measuring attitudes are reviewed. This review culminates in the selection of the semantic differential for adaptation to measure the user satisfaction construct.

The final portion of this chapter focuses on a comprehensive evaluation of the semantic differential methodology. This evaluation provides evidence of reliability, validity, and robustness against rating errors for confirmation of the semantic differential selection. Other advantages of the methodology are also identified.

The conclusions of this chapter indicate that the research objectives are feasible. Furthermore, the analysis of the fundamental propositions provides an answer of "how" to measure user satisfaction.

THE SATISFACTION CONSTRUCT

The concept of satisfaction, particularly in the organizational environment, has been a major subject of study by psychologists (Wanous and Lawler, 1972). The bulk of these studies was directed at a set of satisfaction objects collectively referred to as "job satisfaction" (Smith, Kendall, and Hulin, 1969; Schwab and Cummings, 1973). The research concerned with job satisfaction was reviewed to develop a basic understanding of the character of the satisfaction construct in organizational settings.

Definitional shortcomings were cited as a major research and theoretical impediment by Strong (1967) and by

Schwab and Cummings (1973). Strong (1967:680) stated, "What is satisfaction? Some say it is a kind of feeling as simple as pleasantness; others contend it is a complex of feeling, emotion, and sensation." Subsequent evaluation of satisfaction definitions identified two general categories. These were expressed by Schwab and Cummings after an intensive literature review:

> First, it is often unclear whether satisfaction is being used in a "narrow", need deprivation sense, or in a "broad", attitudinal sense... Beginning with the need deprivation versus attitude issue, satisfaction-dissatisfaction may be thought of in the context of "elementary" motivation theory. Needs, demands, or drives generate tensions (feelings of dissatisfaction). The individual engages in behavior designed to obtain goals or incentives to reduce the tensions (satisfy the need).
>
> Alternatively, satisfaction-dissatisfaction can be thought of as the evaluative component of an attitude. A person may respond affectively (feel satisfied or dissatisfied) about an object or referent in his work environment (Schwab and Cummings, 1973:137).

These two viewpoints of satisfaction were recognized by Smith, Kendall, and Hulin (1969). They defined satisfaction from the attitudinal perspective but acknowledged the effect of the need-deprivation influence on individual frames of reference or satisfaction "anchor points". Although the need-deprivation definition found considerable support in theoretical writings (March and Simon, 1958; Porter, 1961; Locke, 1969), most measurement studies reported were based primarily on the attitudinal definition (Brayfield and Rothe, 1951; Smith, Kendall, and Hulin, 1969; Cross, 1973; Churchill, Ford, and Walker, 1974).

Wanous and Lawler (1972) summarized the measurement models that evolved from these definitions. Although nine models were reported, there were two basic models. The first model, based on the need-deprivation definition and referred to as the discrepancy model, was defined by

$$S_i = \sum_{j=1}^{n} (I_{ij} - A_{ij})\, W_{ij} \qquad (2.1)$$

where

S_i = Satisfaction of individual i

I_{ij} = Ideal state of factor j for individual i

A_{ij} = Actual state of factor j for individual i

W_{ij} = Importance weight of factor j for individual i

The discrepancy model was based on the hypothesis that satisfaction feelings were associated with the perceived difference between an ideal state and the actual state of distinguishable factors in relation to alternatives that were available in a given situation. Thus, the feelings were influenced by not only the actual state of a particular factor but also by the internal standards maintained by an individual under differing circumstances.

Ideally, a unique anchor point representing the ideal state for each factor for each individual subject was required. The alternatives that an individual perceived as available altered this frame of reference. The problems of establishing these anchor points for individuals was a major impediment to implementing this model.

The second model was based on the attitudinal definition of satisfaction. It was defined by

$$S_i = \sum_{j=1}^{n} W_{ij} R_{ij} \qquad (2.2)$$

where

S_i = Satisfaction of individual i

W_{ij} = Importance weight of factor j for individual i

R_{ij} = Raw score of factor j for individual i

In this model, the raw score of a factor was determined by the position of an individual's feelings about that factor on a continuum between a "worst state" and a "best state" for the factor. The measurement problem was therefore changed from the determination of an ideal state contrasted to an actual state to the placement of an individual's feelings on a common continuum. Anchor points acceptable to a wide variety of individuals were still required to establish the underlying continuum.

The other measurement models reported by Wanous and Lawler (1972) were primarily variations of these two basic models. One common variation was achieved by assigning factor weights of unity which resulted in unweighted summation models.

All of the measurement models recognized a basic characteristic of the satisfaction construct. The global or overall satisfaction score was composed of independent

scores assigned to the distinguishable factors. Cross stated:

> Job satisfaction is still commonly referred to as if it were a single variable, but this is unquestionably too simplistic, and the trend is to consider it as a multi-dimensional construct. The reasons for this are largely self-evident... it is feasible to imagine situations where groups of workers are indiscriminable in terms of their scores on an overall measure, yet differ widely in terms of their satisfaction with different aspects of their employment. It seems likely, therefore, that the studies of separate dimensions of job satisfaction will be more fruitful than research which employs only a single global measure (Cross, 1973:193).

Evans had argued the same viewpoint earlier:

> The concept of job satisfaction is a many-faceted one. Although some students see it as a generalized affective orientation to all aspects of the work situation, it is clear that such a view expresses the resultant of a whole host of orientations to specific aspects of the job (Evans, 1969:93).

This multi-dimensional character of job satisfaction created two measurement concerns. One was the specification of the facets or factors that were relevant in a given setting. The second was the consideration of differential weights to reflect the importance of the facets. Notwithstanding these measurement concerns, Wanous and Lawler (1972:103) concluded that "the evidence from the convergent and discriminant validity matrix suggests that it is possible to validly measure peoples' satisfaction with different facets of their job."

This conclusion was supported by the wide acceptance of standardized instruments which measure multiple facets of job satisfaction. The Science Research Associates (SRA)

Employee Inventory measured the attitudinal feelings of individuals and groups toward 14 facets of job satisfaction (Miller, 1970). Moore and Burns (1956) reported that this instrument had been administered to over 500,000 subjects. Another standardized instrument, the Job Description Index, measured satisfaction feelings toward five facets of the job environment (Smith, Kendall, and Hulin, 1969). Both of these measurement instruments were supported by evidence of reliability and validity.

The review of job satisfaction literature supported the following conclusions about the satisfaction construct in organizational settings:

1. Satisfaction could be defined as an attitude.
2. Satisfaction was a multi-dimensional construct.
3. Global satisfaction measures were composed of individual satisfaction feelings toward the distinguishable factors that comprised the construct domain.
4. Satisfaction could be measured.

The extension of these conclusions from an individual's job satisfaction to a user's satisfaction with the computer-based information products and services that are provided within the organization was straightforward. Powers and Dickson (1973:150) defined user satisfaction as the "attitudes of managers receiving project products relative to how well their information needs were being satisfied." This definition of user satisfaction as an attitude was also

supported by Lucas (1973b), Swanson (1974), and Adams (1975).

The multi-dimensional character of user satisfaction was also amply substantiated. Firnberg (1973) identified 16 different factors that influenced user satisfaction in two case studies of different organizations. He indicated that the factors contributed differentially to the overall global feeling of satisfaction. Other writers who identified multiple factors affecting user satisfaction included Fitts (1971), Stone and Tarnowieski (1972), Colton (1973), Constant (1973), and Schussel (1974).

Therefore, user satisfaction is defined as <u>the sum of feelings or affective responses to distinguishable factors of the computer-based information products and services that are provided within the organization</u>. The measurement model which reflects this definition is specified by Equation 2.2.

$$S_i = \sum_{j=1}^{n} W_{ij} R_{ij}$$

Application of this model imposes two very different requirements. One is the delineation of the factors comprising the domain of the user satisfaction construct. The second is the measurement of attitudinal feelings toward those factors. The following sections of this chapter review measurement theory, attitudes, and attitude measurement for insight to achieve the measurement objective.

Scaling methodologies are then evaluated to select a method of measuring the user satisfaction feelings. The domain specification is developed in Chapter 3.

MEASUREMENT

In a discussion of the fundamental nature of measurement, Lorge observed:

> "Measure" is one of the thousand most common words in printed English. As is usual with words that have had a long history and wide currency, "measure" has many different meanings and applications. In a count of its occurrence in a sample of two and a half million words, "measure" occurred more than four hundred times and was used in forty different ways (Lorge, 1967:43).

This diversity of usage sparked an active debate on definitions between scientists, philosophers, and others; however, the definition of measurement often repeated in one form or another was expounded by Stevens:

> We may say that measurement, in the broadest sense, is defined as the assignment of numbers to objects or events according to rules. The fact that numerals can be assigned under different rules leads to different kinds of scales and different kinds of measurement. The problem then becomes that of making explicit (a) the various rules for the assignment of numerals, (b) the mathematical properties (or group structure) of the resulting scales, and (c) the statistical operations applicable to measurements made with each type of scale (Stevens, 1946:677).

This assignment, or classification, of numbers to objects or events was almost invariably performed with some purpose in mind. As Caws succinctly stated, "Measurement presupposes something to be measured, and unless we know

what that something is, no measurement can have any significance" (cited by Churchman and Ratoosh, 1959:1). The philosopher and mathematician Russell echoed that sentiment, "Measurement demands some one-to-one relation between the numbers and magnitudes in question - a relation which may be direct or indirect, important or trivial, according to circumstances" (cited by Churchman and Ratoosh, 1959:21).

These statements indicate that measurement is always concerned with some feature or attribute of the subjects of interest. Attributes which are not concrete and tangible are labeled "constructs" because they are fabricated intellectually rather than conceived as physical entities (Ghiselli, 1964:10). A process of abstraction is necessary to define and to describe any construct before measurement of "how much" of the attribute is present in the measurement object. Cassier made the point that:

> All measure has to be "conceived and sought" before it can be found in experience; i.e., one has first a concept of some quality and looks afterwards for quantitative expressions of it (cited by Churchman and Ratoosh, 1959:8).

Yet, conception and abstraction of constructs such as attitudes satisfy only the first requirement of Stevens' (1946) definition of measurement. Rules must be formulated to assign numerals to achieve certain mathematical properties. Although, many different rule sets have been utilized which result in correspondingly different scales, four basic scales have evolved into common usage and

terminology. These are summarized in Table 2.1.

The nominal scale represents the most unrestricted assignment of numbers. The numbers represent categories of objects. The information that may be derived from this scale is confined to operations which depend solely on frequencies, such as the mode (the most numerous class). Certain contingency tests may be performed that are based on the distribution of objects among the different classes or categories.

The ordinal scale is derived by a rank-ordering of objects according to the attribute of interest. This operation conveys only the information about the relative positions of the objects. There is no indication of "how much" of the attribute is present or how far apart the positions are with respect to the attribute. This shortcoming precludes the use of some of the more powerful methods of mathematics because the mean and standard deviation cannot be used in the analysis.

The interval scale not only rank-orders the objects but also expresses how far apart the objects are with respect to the attribute. It does not convey information about the "absolute" magnitude of the attribute. The usual statistical measures of means, standard deviatons, correlations, and others may be derived from interval scales. The broad score of the analytical methods which may be employed increase the desirability of achieving an interval scale in

Table 2.1 *

Common Measurement Scales

Scale	Basic Empirical Operations	Mathematical Group Structure
Nominal	Determination of equality	Permutation group $x' = f(x)$ where $f(x)$ means any one-to-one substitution
Ordinal	Determination of greater or less	Isotonic group $x' = f(x)$ where $f(x)$ means any monotonic increasing function
Interval	Determination of equality of intervals or differences	General linear group $x' = ax + b$
Ratio	Determination of equality of ratios	Similarity group $x' = ax$

*Adapted from Stevens (1946:678)

the measurement process.

The ratio scale has all of the properties of the interval scale plus the existence of rational zero point with a known distance of the intervals from the zero point. These properties allow multiplicative transformations. The ratio scale conveys information about the absolute magnitude of the attribute "present" in an object.

The scale characteristics of a particular measure of attitude must be judged in an inferential manner. There are no ostensive characteristics of psychological attributes that can be correlated reasonably to specific scale properties, such as a rational zero point. There are perhaps trivial examples, such as the amount of "intelligence" in a stone or a deceased person, but these are meaningless in consideration of significant measurement problems.

Nunnally (1967) presented a cogent argument that each scaling model constitutes a set of axioms or assumptions concerning how the data should look when the measure is put to use. He stated:

> If the data obtained from applying a measurement scale fit the axioms of the model under consideration and the axioms (assumptions) of the model are correct, the measure has scale properties specified by the model (Nunnally, 1967:23).

This method of inferring the scale characteristics from the assumptions and the resulting empirical data is an attempt to test the fit to a model. The realities of measuring attitudes or other psychological phenomena suggest

that this is appropriate. Scales of attributes that are accepted as "good" measures of certain attributes eventually become established as conventions. Nunnally concluded:

> Most persons will agree that measurement plans based on common sense and past experience improve the probabilities of finding a measurement scale that eventually will be accepted as a useful convention.

Within this definitional framework of measurement and the resultant scale properties, the writings of prominent social psychologists are reviewed to provide insight into the nature, components, and properties of the concept of attitude. This review is followed by an evaluation of specific scaling methodologies developed to measure attitudes.

THE CONCEPT OF ATTITUDE

After an extensive review of the history of the concept of attitude, Allport (1967:3) concluded that "the concept of attitude is probably the most distinctive and indispensable concept in contempory American social psychology." He then synthesized a multitude of definitions into a definition of attitude that was widely referenced:

> An attitude is a mental and neural state of readiness, organized through experience, exerting a directive or dynamic influence upon the individual's response to all objects and situations with which it is related (Allport, 1967:8).

Allport's (1967) viewpoint that attitudes were bipolar in direction (positive or negative, favorable or unfavorable) was shared by Thurstone (1967) and Shaw and Wright

(1967) among others. This led to attitude being conceptualized as a unidimensional concept.

Doob (1967) challenged Allport's definition and argued that behavior and attitude were not necessarily related. Chein responded to Doob's argument with the proposal that attitude was actually composed of three elements:

> ... an affective or feeling aspect, a cognitive aspect representing an individual's evaluation of or beliefs about an attitude object, and a conative aspect representing an action tendency toward the attitude object (cited by Summey, 1974:24).

The multiple component definition of attitude, although often included in theoretical discussions, was rarely utilized in attitude measurement studies. Measurements of attitudes regularly reverted to the unidimensional approach that considered the evaluative component to be the essence of the attitude concept. Shaw and Wright observed:

> In short, the typical attitude scale measures the acceptance of evaluative statements about the attitude object. The attitude toward the object is inferred from the statements endorsed by the subject, based upon the consentual evaluation of the nature of the characteristics attributed to the object by the acceptance of these statements (Shaw and Wright, 1967:14).

This viewpoint was expressed earlier in Thurstone's definition of attitude as:

> ... the intensity of positive or negative affect for or against a psychological object. A psychological object is any symbol, person, phrase, slogan, or idea toward which people can differ as regards positive or negative affect (Thurstone, 1931:250).

This definition was adopted by many researchers, including Osgood, Suci, and Tannenbaum (1957), Anderson and

Fishbein (1965), and Shaw and Wright (1967). The definition expressed two characteristics of attitude that had important implications for the measurement of attitude. These were direction and intensity of feeling. Thus, the concept of attitude was subsumed for measurement purposes as a set of evaluative feelings with both direction and intensity toward the characteristics of an attitude object (Oppenheim, 1966).

This concept paralleled the definition of user satisfaction and was mirrored in the measurement model proposed in Equation 2.2. It was concluded that the conceptual differences between attitude and user satisfaction were insignificant in terms of the measurement purpose. Smith, Kendall, and Hulin (1969:1) stated, "The problems associated with the measurement of satisfaction are but specific examples of those encountered in the measurement of any attitude." Therefore, the scaling methodologies that were traditionally used to measure attitudes were evaluated for potential application in measuring user satisfaction.

ATTITUDE SCALING METHODOLOGIES

The most frequently used methods of measuring attitudes were developed by Thurstone, Likert, and Guttman (Shaw and Wright, 1967; Nunnally, 1967). A popular supplement to these methods was the semantic differential technique developed in the 1950's by Osgood, Suci, and Tannenbaum (1957). Each of these methodologies was evaluated for

possible adaptation to the purpose of measuring user satisfaction. The methodology descriptions were condensed from writers that concentrated on attitude measurement (Torgerson, 1958; Shaw and Wright, 1967; Nunnally, 1967; Miller, 1970).

Thurstone Equal-Appearing Interval Scale

This method of scale construction requires a large number of statements (items) related to the attitude object. The items are considered nonmonotone. This implies that persons above or below (positive or negative direction, respectively) the attitude position reflected by an item may disagree with the item. The steps involved in constructing the scale are as follows (Shaw and Wright, 1967:21; Miller, 1970:91):

1. Several hundred statements related to the attitude object being investigated are formulated.

2. A large number of judges (50 - 300) independently classify the statements into eleven groups ranging from the most favorable to neutral to least favorable. These groups are numbered 1 to 11.

3. The scale value of an item is computed as the median position to which it is assigned by the group of judges.

4. Statements which have too broad a spread are discarded as ambiguous or irrelevant.

5. The scale is formed by selection of items which are evenly spread along the scale from one extreme to the other.

The resulting group of statements, each with an assigned scale value, can then be presented to a subject with instructions to check those statements with which the subject agrees. The subject's "scope" is the median value of all of the items that are checked. Theoretically, the subject will agree with only a few statements that are clustered near his "true" attitude position. An example of Thurstone type scale items is shown in Table 2.2.

Table 2.2*

Example of Thurstone Type Scale Items

_____	My job is like a hobby to me.
_____	I am satisfied with my job for the time being.
_____	I am often bored with my job.
_____	Most of the time I have to force myself to go to work.

* Adapted from Miller (1970:92)

This method of scale construction was extensively utilized to measure various attitudes toward referent objects or concepts, including job satisfaction, war, church, capital punishment, and others (Miller, 1970). The validity of the scales depended largely upon the skill of the investigator formulating the statements related to the attitude. Nunnally (1967) argued that it was extremely difficult to achieve items that have nonmonotone charac-

teristics. This led to many of the statement items, particularly those related to the middle of the scale values, to be populated with and's, but's, or's, and other "double-barrelled" indicators within statements (Nunnally, 1967:530).

The primary advantage of the Thurstone type scales was that attitudes could be interpreted directly from the individual scores without reverting to normalized scores which were required in most summation type scales. Nunnally (1967:530) criticized the scales, however, as being of limited use and precision when comparing differences in attitudes of individuals and groups of people.

There were disadvantages to using this methodology for measuring user satisfaction. There were multiple factors which were thought to affect user satisfaction. The multidimensional character of the user satisfaction construct indicated that richer information would be provided if each factor could be measured independently. A vast number of statements, however, would be required to adequately cover the continuum underlying each factor. Therefore, the Thurstone equal-appearing interval method was not considered to be an economical means to the measurement purposes.

Likert-Type Scale

The Likert method of scale construction, like the Thurstone method, requires a large number of statements

about the attitude being investigated. The statements are monotone items with the characteristic that the intensity of the subject's agreement or disagreement with the item results in a higher or lower score for that item. The steps involved in constructing the scale are as follows (Shaw and Wright, 1967:24; Miller, 1970:92):

1. A large number of clearly favorable or clearly unfavorable statements about attitude are formulated.

2. These items are administered to a representative group of subjects. They are asked to respond to each statement by indicating their reaction as:

    a. Stongly agree

    b. Agree

    c. Undecided

    d. Disagree

    e. Strongly disagree

3. The responses are scored as 5, 4, 3, 2, 1, respectively. Negatively worded statements are scored in reverse order, so that a high score indicates the most favorable attitude.

4. Each individual subject's total score is computed by the addition of the item scores.

5. The responses are analyzed to determine which items differentiate most clearly between the highest and lowest quartiles of total scores.

6. The items which differentiate best are used to form a scale.

The Likert-type scale which results from the above procedures is generally considered an ordinal scale which orders individuals along the attitude continuum; therefore, interpretation of the scores has meaning only within the distribution of the scores within the sample. This implies that the scale scores should be standardized on a sample drawn from the subject population of interest. These standardized scores provide the "yardstick" for interpretation of future subject scores.

An example of the Likert type scale is presented in Table 2.3. The subject is required to indicate both the direction (agreement or disagreement) and intensity of his feeling about the statement.

Table 2.3*

Example of Likert Type Scale Items

(1) The future looks very black.

Strongly Agree	Agree	Uncertain	Disagree	Strongly Disagree
____	____	____	____	____

(2) Most people can be trusted.

Strongly Agree	Agree	Uncertain	Disagree	Strongly Disagree
____	____	____	____	____

* Adapted from Miller (1970:93).

Development of a Likert-type scale was generally considered more economical than the development of a Thurstone equal-appearing interval scale, but the problem of the construct domain representation by the set of statements was common to both. Moreover, the ordinal property of the Likert scale was a severe disadvantage. The satisfaction model presented in Equation 2.2 was based on the formulation of anchor points for each factor. The Likert-type scales were not necessarily based upon anchor points which applied to a comprehensive user population; therefore, this scaling methodology was not considered further.

Guttman Scalogram Analysis

This method of scale construction is based on a set of monotone statements that vary in favorableness or unfavorableness about the attitude being investigated. It is predicated on the theory that a unidimensional attitude continuum results in a predicted pattern of responses. An individual responding positively to one statement is expected to respond positively to all other statements with a lower degree of favorableness. Thus, the intensity of the attitude is contained within the arrangement of the attitude statements rather than in the subject's response, as in the Likert-type scales.

The resulting pattern of responses is evaluated to determine if the statements are scalable (unidimensional) or

not. The pattern is determined by arranging the statements in order of lowest to highest favorableness and listing the responses of the individual subjects in decreasing order of the total number of positive responses. An example is illustrated in Table 2.4. A positive response is indicated by a "+". The statement items are ordered by the number of positive responses received from all of the subjects. The subject scores reflect the number of positive responses to the six items.

Table 2.4

Example of Guttman Scalogram

	Least Favorable		Statements			Most Favorable	
Subject	3	6	1	4	2	5	Score
5	+	+	+	-	+	+	5
3	+	+	+	+			4
1	+	+	+	+			4
2	+	-	+	+			3
4	+	+					2

The reproducibility of the scale is determined by the deviations (errors) from the expected response patterns. The errors in Table 2.4 are indicated by a "-". The coefficient of reproducibility is calculated by

$$R = 1 - \frac{\text{total number of errors}}{\text{total number of responses}}$$

If the coefficient of reproducibility is greater than .90, the statements are considered scalable. The steps in constructing the Guttman-type scale are as follows (Shaw and Wright, 1967:25: Miller, 1970:94):

1. Formulate statements that are applicable to the attitude being investigated.

2. Administer the statements to a sample population.

3. Discard statements with more than 80 percent agreement or disagreement.

4. Order respondents from most favorable responses to fewest favorable responses. Order from top to bottom.

5. Order statements from most favorable responses to fewest favorable responses. Order from left to right.

6. Discard statements that fail to discriminate between favorable respondents and unfavorable respondents.

7. Calculate the coefficient of reproducibility. If the coefficient is greater than or equal to .90, a unidimensional scale is said to exist.

8. Score each respondent by the number of favorable responses.

The resulting Guttman scales did not insure equal intervals (equality of units), but rather resulted in an ordinal ordering of the subjects along a unidimensional attitude continuum. The same disadvantages of domain determination and anchor point descriptions of the Thurstone and Likert methods also applied. The Guttman method was

ill-suited for multi-dimensional constructs. Essentially, a separate Guttman scale would be required for each factor.

Semantic Differential

The semantic differential technique was developed by Osgood and his associates to measure the "meaning" of concepts or objects (Osgood, Suci, and Tannenbaum, 1957). The technique was predicated on the role of adjectives in communicating information about the characteristics of objects or concepts. Since it was believed that adjectives conveyed understanding about the meaning of things, it was reasonable to assume that adjectives could be used in a rating process to measure the meaning associated with the objects or concepts of interest (Nunnally, 1967).

The measurement process involved rating the measurement object on a series of bipolar adjective scales separated by a fixed number of intervals (usually seven). The subject was asked to mark the position in the interval which indicated both the direction and the intensity of his feeling toward the measurement object as indicated by the polar adjective terms. An example of bipolar scales is shown in Table 2.5.

Table 2.5

Example of Semantic Differential Scales

Supervisors		
good	:____:____:____:____:____:____:____:	bad
active	:____:____:____:____:____:____:____:	passive
strong	:____:____:____:____:____:____:____:	weak

Meaning was considered to exist as a semantic space that was Euclidian in nature. The originators of the semantic differential stated:

> The essential operation of measurement is the successive allocation of a concept to a series of descriptive scales defined by polar adjectives, these scales selected so as to be representative of the major dimensions along which meaningful processes vary. In order to select a set of scales having these properties, it is necessary to determine what the major dimensions of the semantic space are (Osgood, Suci, and Tannenbaum, 1957:31).

An impressive variety of studies was reported by Osgood, Suci, and Tannenbaum (1957) which utilized factor analysis to explore the dimensions of the semantic space. The studies consistently identified three general dimensions which were labeled Evaluation, Potency, and Activity, often referred to as the EPA structure. Certan adjective pairs were identified with heavy loadings on these three general dimensions. Examples are shown in Table 2.6.

Table 2.6*

Sample EPA Adjective Pairs

Dimensions	Adjective Pairs
Evaluation	good - bad; fair - unfair; wise - foolish; positive - negative
Potency	strong - weak; hard - soft; heavy - light; severe - lenient
Activity	active - passive; quick - slow; busy - lazy; sharp - dull

* Adapted from Nunnally (1967:537)

Several writers equated the evaluative factor with the term "attitude" because nearly all of the adjective pairs imply negative and positive characteristics (Osgood, Suci, and Tannenbaum, 1957:189; Brinton, 1961:289; Shaw and Wright, 1967:30; Nunnally, 1967:537). Osgood and his associates reported the results of two studies designed to evaluate the use of the semantic differential as a measure of attitude. Both studies employed multiple measurements: the semantic differential, Thurstone scales, and a Guttman scale. Correlations with the Thurstone scales ranged from .74 to .84. The correlation of Guttman scale scores with a three item semantic differential scale score was .79. The conclusion was that whatever the Thurstone and Guttman scales were measuring, the evaluative factor of the semantic

differential was also measuring. The authors concluded that:

> The findings of both of these studies support the notion that the evaluative factor of the semantic differential attitude. It is, moreover, a method of attitude assessment that is relatively easy to administer and easy to score (Osgood, Suci, and Tannenbaum, 1957:194).

The method of constructing a semantic differential for attitude measurement is as follows:

1. Name the objects or concepts that are to be measured.

2. Assemble adjective pairs which are indicative of evaluative characteristics for each object or concept and form bipolar scales.

3. Assign numbers to the scale intervals to indicate direction and intensity. Scores for each object or concept are obtained by summing the associated scale scores.

The versatility of the semantic differential technique was documented by the extensive number of researchers who applied it to a wide range of research problems. A bibliography of the literature relevant to the semantic differential technique revealed that over one thousand books and articles were published (Bobren, Hill, Snider, and Osgood, 1968). Haried (1969) reported that over six hundred diverse studies were completed using the semantic differential technique.

The technique seemed ideally suited for multi-dimensional constructs because different factors could be considered as concepts to provide independent factor scores. Furthermore, the complexity of certain factors could be accommodated through judicious selection of the adjective pairs. The bipolarity of the technique matched the bipolar nature of the user satisfaction construct. There were no immediately obvious disadvantages to adapting the semantic differential for measuring user satisfaction; however, a more in-depth review was conducted prior to the methodology selection.

EVALUATION OF THE SEMANTIC DIFFERENTIAL TECHNIQUE

It was previously stated that the semantic differential was developed to measure the "meaning" of concepts. The technique was based on the role of adjectives in the communication process. In order to understand "what" the semantic differential measures, the different facets of "meaning" were distinguished. Oliver stated:

> The most common communication, linguistic, has two aspects to its meaning - connotative and denotative. Denotative, or referential, word meaning identifies the sensorially relevant characteristics (such as dimension and weight) of that being identified. Since these characteristics are descriptive, they generally lack emotional overtones.
>
> On the other hand, and behaviorally more important, words also possess connotative meaning. This is the affective aspect of linguistic communication. It is the aspect of a communication which produces emotional reactions (interpretations). An opinion, belief, or attitude is molded in terms of each individual's connotative meanings (Oliver, 1973:549).

Nunnally (1967) identified association as a third facet of meaning that overlaps with denotation and connotation. "Associations" were those objects that were brought to mind when an individual saw or heard about a particular object. Of these three aspects of meaning, only connotation was important for attitude measurement.

Osgood, Suci, and Tannenbaum (1957) were very explicit that the semantic differential was developed to measure connotative feelings about concepts. Crockett and Nidorf (1967:211) concluded that "the instrument [the semantic differential] is wedded to a detailed and persuasive theory of connotative meaning." Therefore, the semantic differential was intended to extract responses that conveyed information about an individual's feelings toward a measurement object on the basis of what that object meant connotatively to that individual. The concensus of most reviewers was summed up by Nunnally:

> The semantic differential mainly measures connotative aspects of meaning, particularly the evaluative connotations of objects. For that purpose, it probably is the most valid measure of connotative meaning available. Because of the nature of the instrument, it cannot measure nonconnotative associations... The evaluative factor of the semantic differential is almost purely connotative in character rather than denotative or associative. This is why it was said that the evaluative factor should provide a good measure of attitudes (Nunnally, 1967:541).

It was concluded that the semantic differential did measure the appropriate aspect of meaning for the user satisfaction construct. Although the semantic space

associated with the semantic differential was shown to be multi-dimensional, only the Evaluation dimension was used to measure attitudes (Osgood, 1962; Shaw and Wright, 1967; Heise, 1970).

Metric Properties of the Semantic Differential

Traditional use of the semantic differential was based on two assumptions about the metric properties of the individual bipolar scales. These assumptions were that the intervals within the scale were equal and that the zero point occurred at the same place on each scale, namely the midpoint. Messick (1957) utilized the method of successive intervals to evaluate these assumptions.

The seven interval scale used by Osgood, Suci, and Tannenbaum (1957) was assigned the integers 3, 2, 1, 0, -1, -2, and -3 as successive category midpoints; therefore, the assumed boundary values for the response categories were 2.5, 1.5, .5, -.5, -1.5, -2.5. Since the method of successive intervals provided scale values for the boundaries of the response categories, Messick (1957) was able to compare the actual with the assumed boundary values for the nine most frequently used bipolar scales. The results indicated that, while the intervals did not appear to be strictly equal within scales, the intervals did have a consistent size between scales. Also, the zero point occurred at the same approximate position on each scale, a position slightly

on the negative side of the assumed zero point. Further analysis indicated that the interval variations were within the limits that could have occurred due to random error fluctuations.

Messick (1957) then examined the effect of assuming equality rather than using the boundary values established by the successive intervals procedures. The correlations between the two scales for the nine adjective pairs ranged from .984 to .998. The results led Messick to conclude:

> ... that little distortion would be introduced by using successive intervals as category mid-points for these nine scales. Considering this and other indications of the present study, i.e., an approximate equality of corresponding interval lengths from scale to scale and a similar placement of origins across scales, it seems reasonable to conclude that the scaling properties implied by the Semantic Differential procedures have some basis other than mere assumption (Messick, 1957:206).

Messick's conclusions were further supported by Cliff (1959). The seven response categories for each bipolar scale were labeled by the adverb qualifiers _extremely_, _quite_, _slightly_, _neither_ or _equally_, _slightly_, _quite_, and _extremely_ which combined multiplicatively with the polar terms of the scale. Cliff found that this particular set of adverb qualifiers combined with adjective sets to form combinations of nearly equal step functions of intensity of meaning. Thus, the response categories varied in intensity of feeling in near equal intervals.

McCroskey, Prichard, and Arnold (1967) examined the assumption of the origin placement at the scale midpoint. The findings refuted the assumption for individual bipolar scales, but supported it for summated scale scores. The writers stated:

> It appears that although the midpoint of a single bipolar scale may not represent the neutral point in attitude intensity, the midpoint of the range of possible summated scores across six bipolar scales does represent the neutral point in attitude intensity (McCroskey, Prichard, and Arnold, 1967:644).

The question of whether the semantic space was bipolar and whether the scales of the semantic differential accurately reflected this polarity was the subject of a study by Green and Goldfried (1965). The results, based on unipolar scale ratings, revealed that the scale-concept interaction had a great effect not only on the bipolarity but also on the symmetry of the scales anchored by opposing adjectives. Bipolar factors were found for the Evaluation dimension of the semantic space but not for the dimensions of Potency and Activity.

These results were refuted in part by a similar study performed earlier by Taylor and Kumata (cited by Osgood, Suci, and Tannenbaum, 1957:153). Heise (1969) observed that the results obtained by Green and Goldfried would have indicated bipolarity if the unipolar rating had been averaged. Overall, it was felt that the assumption of bipolarity, particularly for the Evaluation dimension, was justified.

The studies that were reviewed supported the following assumptions about the metric properties of the semantic differential. When the individual dimensions of the semantric space were examined independently, the Evaluation dimension received the strongest evidence for these assumptions:

1. The scale intervals were equal.

2. The point of neutral attitude intensity was located at the midpoint of the range of the summated scale values for factor scores.

3. The adjective pairs did anchor a bipolar continuum.

Reliability of the Semantic Differential

Traditional discussions of reliability as a property of measurement instruments centered on the reproduction of scores (Cronbach, 1951). The methods for testing this property typically included test-retest procedures, split-half methods, and parallel forms of the same type of instrument (Summey, 1974). Each of these methods was predicated on the development of reliability coefficients from correlations of the results of at least two different test scores. More recently, these types of reliability coefficients considered as indicators of stability rather than reliability in the sense of the accuracy or precision of the instrument (Kerlinger, 1973).

The conception of reliability as the accuracy of the measurement instrument was a fundamental departure from the reproduction of scores viewpoint. This approach to the determination of reliability was based on a theory of measurement error (Thorndike, 1967; Nunnally, 1967; Kerlinger, 1973). Reliability was defined as the relative absence of errors of measurement in the measurement instrument.

Kerlinger (1973) presented the rationale for a definition of reliability in terms of errors of measurement. For any set of scores obtained by a measurement instrument, the total variance (V) was considered to be composed of the sum of the true variance (V_t) and the error variance (V_e), i.e., $V = V_t + V_e$. Therefore, the reliability of a measurement instrument was indicated by the proportion of true variance to the total variance. The equation for this calculation was given by Kerlinger (1973:446) as

$$r_{tt} = 1 - \frac{V_e}{V} \qquad (2.3)$$

where

r_{tt} = the reliability coefficient

V = total variance computed from the obtained set of scores

V_e = error or residual variance

Kerlinger's equation was computationally equivalent to one proposed earlier by Hoyt (1941). Hoyt utilized an analysis of variance approach and defined reliability by the

expression:

$$\text{Reliability} = 1 - \frac{\text{Error Variance}}{\text{Variance among individuals}} \quad (2.4)$$

Thorndike observed:

> The analysis of variance approach appears useful for obtaining reliability estimates from items or trials which are scored with a range of scores, and not merely "passed" or "failed" (Thorndike, 1967:238).

The semantic differential was subjected to studies directed at both the stability and accuracy aspects of reliability. DiVesta and Dick (1966) studied the test-retest ratings of semantic differential scales by grade school children. A four week time lapse was used between rating periods. The correlations between the two sets of scores were somewhat higher for the higher grades and also for the Evaluation dimension overall. The factor score correlations for the Evaluation dimension for grades two through seven were .39, .49, .75, .86, .79, and .78, respectively. DiVesta and Dick concluded:

> The findings in the present study clearly suggest that over brief periods, the semantic differential is a reliable instrument when used with children. The coefficients of stability are comparable to those ordinarily obtained by other techniques requiring judgments by individuals (DiVesta and Dick, 1966:613).

Two other conclusions from the study merited attention:

> The reliability of the data generated by the semantic differential is higher when ratings from two scales are combined to obtain factor scores than when only single scales are used... For usual research practice, where the concern is with only one to three dimensions, it seems likely that the investigator will choose to combine the scores from three to five scales in order to realize higher stability... Reliability for

> concepts based on group means is higher than that for individuals even when groups are composed of only three to five subjects (DiVesta and Dick, 1966:613).

A test-retest study by Norman (1959) examined the shifts in ratings compared to expected shifts if the ratings were purely random. The results showed that 40 percent of the scale ratings did not shift, 35 percent of the ratings shifted by one scale unit, and 25 percent of the ratings shifted two or more scale units. Some concepts had more stable ratings than others. This difference was apparently related to the extremeness of the concept. Peabody (1962) also found that more neutral concepts were rated with less stability.

It was concluded that the semantic differential did achieve an acceptable degree of stability for both individual and group mean scores, although the group means were significantly more stable. The Evaluation dimension scales demonstrated more stability in test-retest correlations than the other dimensions. Notwithstanding these results, Osgood, Suci, and Tannenbaum argued against the use of correlation type measures as inappropriate for the semantic differential:

> ... the correlation coefficient does not take into account the absolute differences between the means of the two tests; perfect reliability, "r" of 1.00 can occur when an absolute difference of several units exists between test and retest measurements such that not a single score is reproduced (Osgood, Suci, and Tannenbaum, 1957:127).

Summey (1974) used the Kerlinger (1973) equation to evaluate the semantic differential reliability as a function of the errors of measurement in a study of business students' attitudes. The measurement instrument achieved an value of .814 which meant that 81.4 percent of the total variance of the measured variables was accounted for by the measurement technique (Summey, 1974:64). This level of reliability was comparable to reliability coefficients developed in similar research (Heise, 1969).

The use of the Kerlinger (1973) equation was considered to be highly dependent on the particular instrument being evaluated. While the results of the stability studies may be generalized because the research was directed at the semantic differential methodology itself, reliability coefficients based on a particular measurement instrument were not generalizable. Therefore, coefficients to estimate the accuracy aspect of the reliability property must be calculated for any measurement instrument being considered. The stability aspect of the semantic differential, however, was supported by numerous studies. Stability increased when multiple scales were used for factor scores, and group means were more stable than individual ratings. The Evaluation dimension was repeatedly more stable across both concepts and individuals than the other semantic space dimensions.

Validity of the Semantic Differential Technique

A measurement instrument is said to be valid when it measures what it is supposed to measure (Osgood, Suci, and Tannenbaum, 1957:140). Validity has traditionally been a difficult property to document for measurement instruments developed for pyschometric purposes. Nunnally (1967:75) acknowledged that "validity is a matter of degree rather than an all-or-none property, and validation is an unending process."

Three categories of measurement validity have evolved, and these are labeled (1) predictive validity, (2) content validity, and (3) construct validity (Ghiselli, 1964; Nunnally, 1967). Predictive validity is signified by the correlation between the measurement scores and some independent criterion that is assumed to represent the "true" state of the attribute being measured. The absence of an independent criterion has frequently limited the use of predictive validity measures for psychometric measurement instruments designed to evaluate "how much" of an attribute is present in a subject (Nunnally, 1967).

Content validity is determined from the content and operations of a measurement instrument (Ghiselli, 1964). Validity in this sense implies that the content of the construct has been adequately sampled from the construct domain and that the operations to measure this content are

"reasonable". Determination of how well these two requirements are satisfied is often based on logical and subjective evidence.

One approach to minimize the effects of subjective judgments has been the utilization of the homogeneity of the items of the instrument as an indication of validity (Robinson, Rush, and Head, 1974). Homogeneity, also referred to as internal consistency, is based on the argument that component parts of an instrument that purport to measure the same thing should be positively correlated. Therefore, high intercorrelations are indicative of content validity.

Construct validity is based on the explanation of measurement scores within some network of theoretical variables. This type of validity is involved primarily when the scores are to be interpreted in terms of an attribute that has not been operationally defined (Cronbach and Meehl, 1955). Construct validity is determined by the behavior of scores in relationship to other variables theoretically contained within the construct network. Validity is a function of the relationships following a postulated pattern.

Although three types of validity are distinguished, in practice the definitions overlap and different measurement problems pose unique characteristics in terms of validity documentation. As with reliability, validity is viewed as a

property determined by logical as well as statistical arguments. Measurement instruments based on the semantic differential technique have been validated in a number of ways.

Smith (1963) used a criterion-oriented method to validate a semantic differential instrument for rating public speaker effectiveness. A "known group" approach utilized instructor ratings of students enrolled in speech courses to differentiate the students in terms of public speaking ability. These students were then rated using a semantic differential instrument. The high correlations between the two ratings were considered as evidence for validity.

Grigg (1959) utilized a construct validity approach to validate the semantic differential technique. The study involved the expected distances between subjects' concepts of "self", "ideal self", and "neurotic" both before and after experimental manipulation. The expected relationships did occur (the construct network behavior), and Grigg concluded that the evidence supported the validity claim of the semantic differential.

Summey (1974) employed a content validity technique to evaluate a semantic differential for attitude measurement of business students. The validity claim was based on careful articulation of the content development and actual construction of the instrument. Factor analysis was then used to

substantiate the selection of scales to measure the hypothesized factors.

These three examples demonstrated the use of different approaches to validate semantic differential instruments. They were representative of a number of studies claiming the validity of the semantic differential technique. Those specifically concerned with attitude measurement included:

1. Attitude formation (Barclay and Thumin, 1963).

2. Attitudes toward organizations (Rodefeld, 1967).

3. Attitudes toward jobs and occupations (Triandis, 1959; Gusfield and Swartz, 1963).

4. Attitudes toward minorities (Prothro and Keehn, 1957; Williams, 1966).

The evidence was compelling that validity could be achieved in attitude measurement instruments based on the semantic differential technique. This potential, however, was not automatically achieved. Block (1958) reported results unfavorable to the use of the semantic differential in measuring one's "ideal self". Nichols and Shaw (1964) found that validity, as determined by correlations with Thurstone scales, was reduced as the saliency of the concepts being measured was increased. The contradictory evidence confirmed the requirement that each measurement instrument be evaluated for validity in accordance with the measurement purpose.

Sources of Errors in Semantic Differential Ratings

In addition to the errors of measurement reflected in the reliability of an instrument, other factors were identified as potential sources of error in the semantic differential ratings. These were:

1. Response bias
2. Anchoring effects
3. Scale-concept interaction

Response bias was the alteration of a response to a measurement item in such a way that it indicates something other than what the item was intended to measure (Guilford, 1967). The biases of interest were those determined by mental sets, termed response sets, which existed in the subjects completing the measurement instrument. Heise (1969) categorized the response sets most affecting semantic differential ratings as (1) social desirability and (2) scale-checking style.

Nichols and Shaw (1964) found that the saliency of concepts being measured was inversely related to the reliability of the semantic differential scores. This result was attributed to subjects' sensitivity to social repercussions of their ratings and to the fact that the semantic differential was an "obvious" measure of attitude, i.e., not disguised. This result was supported by the findings of a study by Ford and Meisels (1965) who found high correlations between independent measures of the social

desirability of semantic differential scales and the factor analysis loadings of the scales on the Evaluation dimension.

The conclusion suggested by Heise (1969) was that the semantic differential may not be especially well suited for the measurement of socially sensitive topics. It was not felt that the user satisfaction construct was one of such "social sensitivity" that this type of response set would greatly affect the scores obtained from semantic differential ratings.

The response set identified as scale-checking style was found by Peabody (1962) to be important for semantic differential usage. Specifically, he found that some subjects appeared to use the end positions of the scale responses more often and to avoid the use of the intermediate positions. After a comparison of abnormal and normal subject group semantic differential ratings, Arthur (1966) confirmed that subjects in the abnormal groups had a significantly higher proportion of extreme responses than normal subjects. Heise reviewed 14 studies which examined the scale-checking style of subject groups differentiated by age, IQ, F scores (a measure of authoritarianism), sex, neurosis, and psychosis, and he concluded:

> The available research documents the existence of basic differences between people in the extent to which extremes are checked. Therefore, exaggeration bias should be a considered variable in experiments, controlled either by random assignment of subjects into experimental and control groups or by attempting to

measure the effect in order to control for it statistically (Heise, 1969:409).

This type of response set could distort the interpretation of semantic differential scores; however, it was an unresolved issue whether the bias actually represented a variation from the "true" score or was a measure of a subject's propensity to exaggerate which perhaps should be considered as a confounded part of a subject's attitude (Nunnally, 1967). The nature of this type of response set precluded any attempt to "extract" this bias from a semantic differential. It was decided to follow the advice of Guilford (1967) and attempt to control the effects of response sets through the use of good measurement instrument formats and clear, appropriate instructions suitable for the subject population.

Another potential source of error was the effect of anchoring, sometimes referred to as context, on the semantic differential ratings (Torgerson, 1958). Anchoring was the tendency of a subject, while rating a list of stimuli, to assimilate carry-over effects from one or more stimuli to the next. In other words, the order of the stimuli could affect the ratings assigned to an individual stimulus within the set.

Somer (1965) examined this effect on semantic differential ratings by preceding test items with positive and negative contexts. One example was the test item, winter,

which was preceded by either hate, steal, and devil (negative context) or by faith, peace, and sunlight (positive context). The test results indicated that the semantic differential ratings were very resistant to anchoring effects. These findings agreed with an earlier study conducted by Aiken (cited by Osgood, Suci, and Tannenbaum, 1957).

There was one other potential source of error. After ten years of concentrated research devoted to the methodology, application, and theory of the semantic differential, Osgood (1962:24) stated that "the preceding evidence as a whole forces us to the conclusion that there is significant interaction between concepts and scales in the process of semantic judgement."

It was felt that the scale-concept interaction phenomenon was the most important potential source of error in a semantic differential designed to measure user satisfaction. As Nunnally (1967:539) pointed out, "whereas 'rugged' is positively evaluative when applied to men, it is not positively evaluative when applied to women." Brown's (1958) classic question, "Is a boulder sweet or sour?", was a succinct expression of the crux of the scale-concept interaction problem.

The selection of scales (bipolar adjective pairs) for measuring a concept should satisfy three criteria: (1) factorial composition, (2) relevance, and (3) semantic

stability (Osgood, Suci, and Tannenbaum, 1957; Summey, 1974). The factorial composition criterion requires that the scales be highly loaded on a particular factor (semantic space dimension) being measured and minimally loaded on all other factors which may be elements of the concept. These loadings may be determined by factor analysis. The relevance criterion requires that the adjective pairs be appropriate descriptors for the concept being measured. The criterion of semantic stability is indicated by the lack of confusion about how a scale applies to a particular concept. Careful adherence to these three criteria during the scale selection process should minimize any errors caused by scale-concept interactions. As stated by Heise:

> The existence or possible existence of concept-scale interaction, whether it is a function of relevance or stimulus environment, means that a semantic differential ideally should be validated and adjusted for every new stimulus class with which it is used... More precise measurements will be attained only by tailoring instruments to each content domain so as to control for true concept-scale interactions (Heise, 1969:418).

Advantages of the Semantic Differential

In addition to the evidence for the semantic differential methodology as reliable, valid, and robust against rating errors, other advantages for the use of the semantic differential to measure user satisfaction were noted. These advantages were:

1. No required subject verbalization
2. Natural anchor points

3. Direct interpretation of scores
4. Economical instrument construction and modification
5. Economical subject test time
6. Adaptability for weighting functions
7. Objectivity

Kaufman stated, "Major assets of the semantic differential include the fact that it requires no verbalization on the part of the respondents and that it measures emotional reactions rather than rational or well-reasoned ones" (cited by Klapper, 1959:437). The lack of required subject verbalization was perceived as very important in view of the findings of Fingeld (1966) which revealed that the ability of persons to select words to convey intended meanings showed wide variance. Moreover, no significant relationship was found between the ability to select words and a subject's general intelligence, verbal-reasoning ability, vocabulary, sex, or advanced training in speech. The semantic differential format which precluded subject articulation of meaning, therefore, required careful selection of scales for each concept being measured.

The measurement model specified in Equation 2.2 was

$$S_i = \sum_{j=1}^{n} W_{ij} \; R_{ij}$$

This model was predicated upon the establishment of attitude continuums for each facet of the satisfaction construct. A

meaningful continuum had to be defined with anchor points that were acceptable to a wide variety of users which comprised the population of interest. The semantic differential established natural anchor points which, when combined with the adverb "extremely", were acceptable to a wide variety of potential subjects (Cliff, 1959).

The semantic differential scores were subject to direct interpretation. The assignment of integer values to the response categories established maximum and minimum values for the continuum. Utilization of average scores for each facet of the construct, scale sums divided by the number of scales, permitted direct interpretation of a subject's relative position on a particular continuum. In contrast, Likert-type scale scores required normalization within a particular subject group for meaningful interpretation.

The construction of a semantic differential was considered more economical than either Thurstone, Likert, or Guttman scale instruments. This advantage primarily stemmed from not requiring a large number of judges to sort and assign values to many statements reflecting the content domain. The semantic differential format also allowed rapid modification, either reduction or enhancement, to reflect unique characteristics of the subject group or measurement puupose. Although any such rapid modifications may lack sophisticated confirmation of validity and reliability properties, adherence to the scale selection criteria could

allow measurement studies to be undertaken with a reasonable degree of confidence.

Kiesler, Collins, and Miller (1969) pointed out that fatigue factors caused by excessive instrument length, particularly in uncompensated subjects, could greatly increase measurement errors. The semantic differential allowed data to be collected rapidly. Osgood, Suci, and Tannenbaum (1957) reported that subjects could easily complete 400 judgments per hour. Heise (1970) challenged this rate as very generous and suggested that even the slowest of subjects could make judgments at a more rapid rate. This allowed a very large amount of information to be collected per unit time from individual subjects.

The semantic differential format was also amenable to individual factor weighting. The addition of a single scale for importance allowed the subject to indicate the saliency of each particular concept (Mobley and Locke, 1970). Weighting functions could then be established by assignment of weights to each response category for the importance scale.

The semantic differential required no subjective judgment on the part of the investigator administering the instrument. The subject responses were directly quantifiable. Thus, the objectivity of the semantic differential yielded verifiable, reproducible data from all subjects completing the ratings. This advantage allowed cross-study

comparisons which facilitated the research process.

SUMMARY

The user satisfaction construct was established as a multi-dimensional attitude. A measurement model that reflected the multiple facets of the construct was proposed. The model

$$S_i = \sum_{j=1}^{n} W_{ij} R_{ij}$$

was additive with each factor score representing a subject's position on an underlying continuum. Each factor was to be weighted to express the saliency of a particular factor to an individual subject.

A review of traditional measurement scales revealed the advantages of achieving at least an interval scale with the measurement process. The scaling methodologies most often utilized in the measurement of attitudes were examined, and the semantic differential technique was selected as the most appropriate for measuring user satisfaction.

This selection was based on the pervasive theoretical and empirical evidence that the semantic differential, properly constructed for the content domain, resulted in a reliable, valid, and robust instrument for the measurement of attitudes. The metric properties of the semantic differential scales were demonstrated as:

1. The scale was an interval scale.

2. The zero point of attitude intensity was located at the midpoint of the range of summated scales.

3. The scale was a bipolar continuum.

Other advantages were identified that also contributed to the selection. Although the semantic differential methodology was considered relatively straightforward, the importance of scale selection of bipolar adjective pairs was noted. Adjective pairs utilized in a semantic differential should satisfy the criteria of:

1. Factorial composition

2. Relevance

3. Semantic stability

The analysis of the underlying assumptions established the foundations for the conduct of this research study. The results of this chapter gave insight into the measurement problem and described the measurement model. The results also provided the fundamental basis to answer the question of "how" to measure the user satisfaction construct. The next chapter defines the content domain by distinguishing the different factors which comprise the user satisfaction construct.

Chapter 3

DOMAIN OF THE USER SATISFACTION CONSTRUCT

This definition of the user satisfaction construct is based on the existence of distinguishable factors which influence the construct. A fundamental prerequisite to the measurement of user satisfaction is the careful identification of the factors which form the construct domain. These factors, when combined with the semantic differential methodology, determine "what" is to be measured by the concrete measurement actions.

This chapter describes the methodology for identifying the distinguishable factors which form the domain of the user satisfaction construct. A literature review is presented which examines previous attempts to measure user satisfaction. The literature review also provides the basis for establishing the initial list of factors. Operational definitions and a short discussion of each factor to be included in the domain are given.

These factors were examined by an independent group of expert judges as a first step to determine the completeness of the specified factor list. The results of this examination and the expanded list of factors that evolved is reported. The expanded list of factors was then subjected to an empirical test to determine the completeness of the list. Data collection for the test required an extensive

interviewing and data extraction methodology which is described. Finally, the empirical test results are presented to firmly establish the factors which comprise the domain of the user satisfaction construct.

LITERATURE REVIEW

Many writers have considered user satisfaction important; yet, few have attempted to measure it. The principal literature that was reviewed for this phase of the research was primarily concerned with the effectiveness of the EDP function within organizational settings as an influence on an individual user's satisfaction. The review focused on identifying studies, surveys, reports, or interviews that not only dealt with a specified user population, but also indicated the underlying factors in the user-computer relationship that were considered important. There was, unfortunately, a paucity of literature that directly addressed user satisfaction. The vast majority of the literature that was examined was oriented toward some purpose other than user satisfaction. Studies were identified, however, which contributed piecemeal information about the factors which affect a user's satisfaction.

These studies were located primarily through the use of bibliographical sources and personal examination of the prominent publications concentrating on EDP subjects. Computers in the Organization was published by the Defense Logistics

Studies Information Exchange (1974) and contained 117 entries. The second annotated bibliographical source, the Quarterly Bibliography of Computers and Data Processing (1974, 1975, 1976), provided periodic abstracting coverage of 100 journals relevant to the EDP field. Pertinent books and reports were also included. The final bibliographical source by McLean, Mason, and Foote (1975) listed 526 entries on the behavioral and organizational aspects of computers and allied technology.

The purpose of the literature review was two-fold:

1. To identify any previous attempts to measure user satisfaction.

2. To identify factors which influence a user's satisfaction with the computer-based information products and services that are provided within the organization.

Three studies did address the measurement of user satisfaction. In each study, this effort was a peripheral task rather than the main objective of the research. The first of these studies was initiated by Powers and Dickson (1973). The research objective was to identify factors which were correlated with successful management information systems (MIS). Thirty-four factors were hypothesized which could possibly affect the success or failure of MIS projects. These factors were then ranked by a group of expert MIS professionals, and 11 of the 34 factors were selected for a field study. Four success criteria were selected to

test the investigators' hypotheses. The criteria of success were (Powers and Dickson, 1973:150):

1. Time - actual time to complete the project/time estimated for the project.

2. Cost - actual cost to develop the project/budgeted cost.

3. User satisfaction - attitudes of managers receiving project products relative to how well their information needs were being satisfied.

4. Computer operations - the impact of the project on the computer operations function.

Data was collected via an interview process in ten different companies. After comparing the relationship of the eleven factors to the four success criteria, the authors stated, "With respect to MIS projects, it is our opinion that the user satisfaction criterion is the most critical one of the four posited for this study" (Powers and Dickson, 1973:153). A major deficiency of the study was the lack of a methodology to quantify the extent of user satisfaction.

Lucas (1973a) employed a questionnaire in his study of the relationship between users and the information services department of seven companies. He found a strong relationship between certain management and system design practices of the information services department and the attitudes and perceptions of the users. Lucas used the terms "attitudes

and perceptions" in a fashion that corresponded to the definition of "user satisfaction".

The questionnaire utilized by Lucas to quantify the level of user attitudes and perceptions consisted of a series of scales related to the following factors:

1. Attitudes toward the EDP staff
2. Ratings of computer potential
3. Perceived quality of input
4. Perceived quality of output
5. Training received
6. Involvement reported
7. Perceived management support

The questionnaire items were formulated as statement completion responses. Responses could be varied along a seven interval continuum between a positive and negative statement. Each factor score was determined by the mean response to all scales related to a particular factor.

The primary shortcomings of the questionnaire used by Lucas stemmed from the lack of completeness and validation of the instrument itself. The actual source of the items selected for each scale was not stated. If any validation of the questionnaire was performed, the methodology and results were not reported. There were several factors which were not included in the questionnaire that other studies considered to be important (Colton, 1973; Firnberg, 1973). These criticisms of Lucas' questionnaire were tempered by

the realization that his research objective was the relationship between other factors and the measurement values of the user's attitudes and perceptions, not the measurement process itself.

A more recent attempt to measure user satisfaction was conducted by Swanson (1974) in his study of the relationship between a user's involvement with and appreciation for management information systems (MIS). The term "appreciation" was described in the following statement:

> The MIS appreciation of a manager consists of his manifold of beliefs about the relative value of the MIS as a means of inquiry. A manager's appreciation of the MIS is to be described in terms of his assessment of the system as a means to his own ends. Thus, if a manager believes his MIS reports to be "timely", "informative", "easy to understand", and so forth, we might say that he appreciated the system's reports (Swanson, 1974:179).

It was clear from the above statement that Swanson's use of the term "appreciation" was similar to the term defined by "user satisfaction". Swanson, like Lucas (1973a), utilized a questionnaire to indicate MIS appreciation. The questionnaire consisted of 16 items which required statement completion responses. The responses could be varied along a five interval continuum between a very positive and a very negative statement. Each interval was assigned a value ranging from .1 to .9. The index of appreciation was defined as the simple average of the 16 individual items. Swanson made two assumptions in constructing the index:

> First, it is assumed that the items chosen are an adequate sample from the universe of items which would indicate the relative presence or absence of MIS appreciation. Secondly, it is assumed that the items are equivalent indicators and that they should be weighted equally in the scoring (Swanson, 1974:183).

The first assumption may or may not be valid. Although the results of Swanson's study were based upon the indexes constructed from the questionnaire, no evidence to substantiate this assumption was reported. The second assumption of equal weighting was equally unsubstantiated. Results reported in this document show that users do not consider different factors equally important; therefore, the equal weighting of factor scores could distort the resulting index measurement.

Powers and Dickson (1973), Lucas (1973a), and Swanson (1974) utilized three different means to measure variables very similar to the variable of user satisfaction. Although deficiences preclude their universal adoption, they did offer clues to what factors do influence user satisfaction. Additional literature was reviewed to formulate a comprehensive list of factors that other researchers considered important to user satisfaction. The criterion for the studies to be considered was that the study or article be based upon results of interaction with users or user groups. Nineteen additional studies identified factors to be included on the list. The studies are summarized in Table 3.1 by year, authors, subjects, methodology, and research

purpose. The number of observations or subjects in each study is denoted by "n".

Each of the studies summarized in Table 3.1 was reviewed to extract those factors, either explicitly considered in the research or revealed by user comments, that influenced the satisfaction of users or user groups with computer-based information products and services. For convenience, the factors were grouped into five categories expressed by the components of the model illustrated in Figure 3.1.

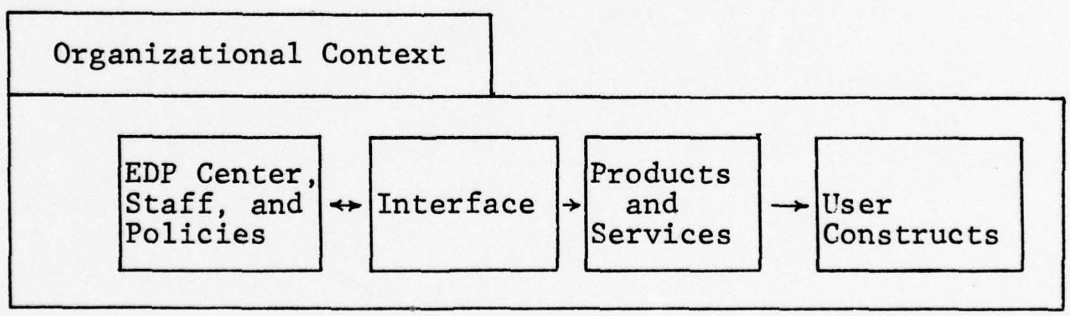

Figure 3.1

Model of Factor Categories

This model denotes a symbolic representation of the relationship of the user and the information products and services that are provided. This relationship exists within an organizational context. The source of the product or service, is expressed in the model as the EDP center, staff, and policies. The interface between the user and the

Table 3.1

Studies Reviewed for Factor Identification

Year	Authors	Subjects	Methodology	Purpose
1969	Churchill, Kempster, and Uretsky	Personnel in 12 companies	Interviews	Utilization of the computer within the companies studied
1969	Diebold	Executives in 140 companies (n=2,500)	Survey	Criteria for judging cost-effectiveness
1969	McKinsey and Company, Inc.	Computer systems management in 36 companies	Interviews	Study of computer systems management
1970	Hofer	Managers in 2 companies (n=80)	Interviews	Organizational structures and processes impacted by computers
1971	Fitts	Case study	Interviews	The effect of EDP on management theory
1971	Teichroew	Committee (11 members)	Discussion	Education related to the use of computers

Table 3.1 (continued)

Year	Authors	Subjects	Methodology	Purpose
1972	Stone and Tarnowieski	Information system and general management (users) (n=357 and 220, respectively)	Questionnaires	Differences in attitudes and viewpoints between information system executives and general management
1973	Powers and Dickson	Personnel in 10 companies	Interviews	Correlates of MIS project success
1974	Gupta	150 of the 500 largest U.S. ccmpanies	Survey	Effectiveness of management information systems
1974	Holland	MIS users in 3 companies (n=33)	Interviews	Socio-technical factors involved in MIS design and implementation
1974	Lucas	Users of 20 information systems in 7 companies	Interviews and company records	Effects of computer-based information systems on decision-making

Table 3.1 (continued)

Year	Authors	Subjects	Methodology	Purpose
1974	Schussel	Management seminar Participants (n=200+)	Question-naires	Evaluating EDP performance
1974	Swanson	Engineering personnel in a manufacturing company (n=37)	Question-naires and company records	Relationship between user involvement and user appreciation of information systems
1973	Adams and Schroeder	Middle manage-ment in 10 companies (n=39)	Interviews	User attitudes about information systems
1973	Colton	Police depart-ment personnel (n=143 inter-views, 376 questionnaires)	Interviews question-naires	Patterns of success and failure in police use of computers
1973	Constant	Case study	Interviews and company records	Reasons for MIS rejection

Table 3.1 (continued)

Year	Authors	Subjects	Methodology	Purpose
1973	Dearden and Nolan	Case study	Interviews	Effects of charge-back on computer resource control
1973	Firnberg	Case Study	Interviews	Effects of on-line systems
1973a	Lucas	Users of information services (n=616)	Question-naires	Correlates of management practices, system design, and user attitudes and perspectives
1973b	Lucas	Users in 15 companies (n=2,000+)	Survey	Computer users' attitudes and perspectives
1974	Tomeski	Personnel in 100 companies	Unreported	Human problems related to computers
1975	Adams	Management users in 10 companies (n=75)	Interviews	Attitudes of managers toward information systems

source, and the product or service itself are also components. Finally, the user has internal constructs which influence his state of satisfaction. These constructs are categorical feelings which are germane to each individual user. The feelings exist on the basis of internal standards which form the user's frame of reference in the evaluation process.

The 36 factors which were identified from the literature cited in Table 3.1 are listed in Table 3.2. Operational definitions and a short discusssion of each factor are presented in the next section. A matrix of the factors and the different studies which identified them is illustrated in Appendix 3.1. The most striking characteristic of this matrix was the relatively small number of factors mentioned in any one study. The factor mentions ranged from 1 to 16 with an average of 7.5. This was only partially explained by the different research objectives that are represented. The more obvious explanation was the heretofore unarticulated research specifically directed at identifying the set of factors that influence user satisfaction.

Operational Definitions of the Factors

An operational definition was formulated for each factor that was identified in the literature review. Some of the factors were relatively simple and straightforward,

Table 3.2

Factors Identified from Studies

Factor	Category
Top management involvement Organizational competition with EDP unit Priorities determination Charge-back method of payment for services	Organizational Context
Relationship with the EDP staff Communication with the EDP staff Technical competence of the EDP staff Attitude of the EDP staff Schedule of products and services Time required for new development Processing of change requests Vendor support	EDP Center, Staff, and Policies
Response/turnaround time Mode of interface Convenience of access	Interface
Accuracy Timeliness Precision Reliability Currency Completeness Format of output Language Volume of output Relevancy Error recovery Security of data Documentation	Quality of Systems
Expectations Understanding of systems Perceived utility Confidence in systems Feeling of participation Feeling of control Degree of training Job effects	User Constructs

while others reflected the aggregation of several complex facets of a particular aspect of the computer-based support. The level of aggregation attempted to subsume these different facets without a severe loss of information. The different perspectives of a complex factor, such as the Relationship with the EDP staff, were influenced by an extensive literature review that encompassed many sources beyond those cited in Table 3.1.

The definitions were formulated to avoid the definitional problems described by Jones in his research on organizational factors:

> The entities of the organization would, no matter how coercively real they might appear, tend to escape a tight exact definition... Attempts at definition often have diffused frustratingly the image of a concept which had appeared previously as vivid and precise (Jones, 1964:10).

Consequently, the definitions are intended to apply to a broad spectrum of users rather than to conform to overly rigid specificity. A brief discussion is also provided for each factor where appropriate. The operational definitions and discussions are shown below.

> Top management involvement: The positive or negative degree of interest, enthusiasm, support, or participation of any management level above the user's own level toward computer-based information systems or services or toward the computer staff which supports them.

The literature consistently extolled the virtue of positively involved top management as a stepping stone to "success" in the implementation and utilization of computer

based information systems (McKinsey and Company, 1969; Hofer, 1970; Fitts, 1971; Colton, 1973). Involvement is an attribute reflecting the degree and direction of the management's support and enthusiasm for or against computer-based information systems. The attribute may be manifested in numerous ways, such as the relegation of total responsibility to a high or low organizational hierarchical level, public remarks denegrating or praising the use of computers, personal involvement or non-involvement with planning and/or major operational decisions, and others.

The users themselves reflect the attitudes of top management according to Constant (1973). He observed in one organization that during two periods of radically different top management attitudes and involvement, the prevailing attitudes at the top levels spread throughout the organization.

Holmes emphatically stated:

> It is absolutely certain that any softening in interest, involvement or support demonstrated by top management will flow freely down through all segments of the organization and present a major handicap to the success of any information system (Holmes, 1970:27).

<u>Organizational competition with the EDP unit</u>: The contention between the respondent's organizational unit and the EDP unit when vying for organizational resources or for responsiblity for success or failure of computer-based information systems or services of interest to both parties.

In an extensive survey involving 577 respondents, Stone and Tarnowieski reported:

> There is some evidence in our study that both system users and systems builders retain a goodly number of belligerent thoughts. In some instances they may do so because they regard each other primarily as competitors and secondarily as collaborators-and then only because of circumstance (Stone and Tarnowieski, 1972:8).

The feelings of competition between the user's organizational unit and the EDP unit can spring from several sources. One source may be the straightforward competition for the organizational resources of capital and manpower. It is not untypical for the budget and manpower allocations for EDP to be expanding at the same time that cutbacks are being forced on other organizational units (Miller, 1971).

Both organizational units may claim credit for functional improvements when computer systems are involved. Like-wise, the blame for the failure of new information systems to achieve expectations may also be vigorously contested. Competition fostered under these conditions can lead to conflict which greatly affects the user's satisfaction.

> Priorities determination: Policies and procedures which establish precedence for the allocation of EDP resources and services between different organizational units and their requests.

The policies establishing precedence for service when demand outstrips capacity, the schedules for new application development, and other actions affect the user's perception of the priorities associated with the allocation of the EDP resources. The determination of these priorities can have a significant effect on the user's access and utilization of

computer-based information services.

This factor appears to have a more pronounced effect when the organizational differentiation is marked by clearly competitive units (Constant, 1973). An example of such an organization would be a university where the administrative functions compete with the academic functions for a limited EDP resource. The competition between the R&D functions requiring rapid turnaround of unique applications and the regularly scheduled production type functions in an organization is another example.

These examples illustrate situations whereby the user's perception of the priorities associated with his demands on the EDP resource could affect his satisfaction. The factor may be interpreted as one measure of the user's functional competitive position within the organization.

> Charge-back method of payment for services: The schedule of charges and the procedures for assessing users on a pro rata basis for the EDP resources and services that they utilize.

The arguments for and against methods of charging users for the EDP resources on a pro rata basis have been explored by several investigators (Dearden and Nolan, 1973; Lucas, 1973b). Notwithstanding the merits or demerits of these arguments, Lucas (1973a) did find a relationship between the user attitudes and the existence or absence of a charge-back method of payment in operation.

Thus, the charge-back method can affect the user's satisfaction with his support. The user may perceive the method itself to be unfair. The user may also feel constrained to operate under the charge-back system without having the option of seeking more economical service elsewhere. A method biased in favor of a particular user may have an opposite effect. This factor appears to affect user satisfaction only when the charge-back method is being used. The absence of such a method does not seem to have an effect (Lucas, 1973a).

> Relationship with the EDP staff: The manner and methods of interaction, conduct, and association between the user and the EDP staff.

The user's concept of his relationship with the EDP staff is a complex factor. The relationship is influenced by a multitude of other factors. Fitts suggested some of the influences:

> Poor relations between computer personnel and functional departments may be caused by (1) failure to "sell" the computer role in the organization, (2) computer operation oriented on computer efficiency rather than customer satisfaction, (3) failure of computer personnel to understand organization goals and priorities, and (4) poor overall computer operaton (Fitts, 1971:48).

The list of influences cited by Fitts (1971) was not complete. Constant (1973) noted that the computer personnel in one company were regarded with great hostility because of their apparent loyalty to the computer profession above the needs and requirements of the organization. The relationship was also affected by the attitudes and habits of the

computer personnel who had direct contact with the users.

The relationship between the user and the EDP staff is characterized by the dependencies which are created by the nature of the relationship. Lucas (1973b:29) observed that "the relationship between users and the information services unit is asymmetric because the information services staff often feels it must understand users' jobs whereas the reverse is not true."

In their model of interdepartmental conflict, Walton and Dutton (1969) argued that such an asymmetric dependency leads to conflict. Conflict, which may vary in intensity, could influence the user-EDP staff relationship and, subsequently, the user's satisfaction.

> Communication with the EDP staff: The manner and methods of information exchange between the user and the EDP staff.

Communication between the user and the EDP staff is beset with many obstacles. One of the primary obstacles is the lack of a common language or jargon (Teichroew, 1971). The EDP environment abounds with terms which have meaning only within that narrow milieu. Many user groups likewise have a jargon designed to fit their job environment. Rarely, do the two share much common ground. After an intensive study, Teichroew flatly states:

> There is a lack of communication between the managers and staff personnel, between those who are the users of administrative information systems and those with the technical knowledge to conceive and implement such systems (Teichroew, 1971:579).

Communication is also hindered by the lack of a conceptual framework which can be understood by both groups. Therefore, users find it difficult to express their needs explicitly. This frustrates the system developers who strive to "lock-in" a system design before they begin actual development. In a study of the factors correlating to MIS success, Powers and Dickson (1973) found evidence that an evolutionary type of system development which utilized the user's learning process in his own information decision situation significantly increased the user's satisfaction. Thus, the degree of success that is achieved in communication between the user and the EDP staff can have a material effect on the user's satisfaction.

> Technical competence of the EDP staff: The computer technology skills and expertise exhibited by the EDP staff.

Colton (1973:94) found that the competence of the EDP staff had a material effect on the success, and subsequent user satisfaction, of computer-based information systems in police departments. This effect was refected in the user's confidence in the systems produced and in the user's propensity for risk-taking in the developmental process. The lack of competence can lead to increased user frustration when problems cannot be resolved rapidly with a minimum of downtime.

<u>Attitude of the EDP staff</u>: The willingness and commitment of the EDP staff to subjugate external, professional goals in favor of organizationally directed goals and tasks.

The perceived attitude of the EDP staff is often described as being "user-oriented" or "EDP-oriented". This attitude impression is often expressed by users in terms of organizational loyalty. As previously stated, the lack of organizational loyalty can lead to outright hostility between users and the EDP staff (Constant, 1973). This result occurs because the users view the EDP staff as using their position and competence in a misdirected fashion. The user-oriented staff, however, is perceived as one that is empathetic to the user requirements and problems. This evaluation of the attitude of the EDP staff can affect the user's overall satisfaction.

<u>Schedule of products and services</u>: The EDP center timetable for production of information system outputs and for provision of computer-based services.

This factor expresses how well the production schedule of the EDP center corresponds to the user requirements. One example would be the time of day that a system report is processed contrasted to the time of day that the user wants to receive the report. The frequency is also a consideration. A service example would be the allocation of six hours a day for on-line processing when a user desires eight hours a day for terminal operations.

<u>Time required for new development</u>: The elapsed time between the user's request for new applications and the design, development, and/or implementation of the applications systems by the EDP staff.

The ability of the EDP staff to respond to new development requests can have quite an effect on the user's satisfaction (Neuschel, 1971; Stone and Tarnowieski, 1972; Colton, 1973). In a survey of 220 general managers (users), 72 respondents considered consistent "on time" development a primary criterion for evaluation of the EDP function (Stone and Tarnowieski, 1972).

This factor is heavily influenced by the user's expectations. It is subject to misconceptions about the ease or difficulty of the technical problems involved in developing new systems. The reasonableness of the time required for new development is linked to the individual user's internal judgmental structure.

<u>Processing of change requests</u>: The manner, method, and required time with which the EDP staff responds to user requests for changes in existing computer-based information systems or services.

As one user stated, "I want to be able to make changes as the world changes" (Constant, 1973). Fitts (1971) found unresponsiveness to change requests a major irritant to users in his study. The explanation may be the rising expectations of users as their contact with EDP technology increases, as well as changes in their job environment (Lucas, 1973a).

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MEASUREMENT OF COMPUTER USER SATISFACTION.(U)

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<u>Vendor support</u>: The type and quality of the service rendered by a vendor, either directly or indirectly, to the user to maintain the hardware or software required by that user. A vendor is distinguished by his external organizational status.

The increased use of terminals by users and the growth of dedicated mini-computers for functional operations has increased the direct user-vendor contact (Hobbs and McLaughlin, 1974). This contact is also increased by the use of purchased software packages which are maintained by the vendor. This relationship is characterized by the same dependencies expressed in the user-EDP staff relationship.

<u>Response/turnaround time</u>: The elapsed time between a user-initiated request for service or action and a reply to that request. Response time generally refers to the elapsed time for a terminal type request or entry. Turnaround time generally refers to the elapsed time for execution of a program submitted or requested by a user and the return of the output to that user.

In a case study of two companies with a heavy emphasis on terminal usage, Firnberg (1973:132) noted, "The users found the 5-10 second response time satisfactory, the occasional 20 seconds were frustrating". Colton (1973) found that response time was even more critical to some applications users in police departments.

In a study of the behavioral factors in information systems, Testa reported:

> An examination of these time-sharing systems, however, reveals a pervasive failure to consider human behavioral capabilities. For example, the frequent occurrence of response delays in time-sharing systems can be disruptive of problem solving... delays of approximately 15 seconds cause deteriorated performance in problem solving situations (Testa, 1974:16).

Turnaround time was a major source of dissatisfaction in Constant's (1973) study. He discovered that delayed turnaround of specialized engineering application programs was responsible for work stopages. Progress on the engineering projects could not proceed until the output was received from the EDP center. The lack of rapid turnaround created great hostility between the two departments.

These limited examples highlight the effect of response/turnaround time on the user's satisfaction. Although the two aspects are different, they are combined into one factor. This combination reflects the tendencies of users to be concerned primarily with either response or turnaround time, not both.

<u>Mode of interface</u>: The method and medium by which a user inputs data to and receives output from the EDP center.

This factor is defined by the means by which the user inputs data to and receives output from the EDP center. Thus, a user's mode of interface may be a deck of data cards submitted by mail carrier and the printed hard copy received after processsing via the same carrier. Another mode of interface may be a single terminal for both transmission and receipt of information. The many possible combinations all vary in the convenience, speed, cost, etc. for the user.

The effect of the mode of interface on the user was discussed by several authors. Lucas (1973a) found that on-line systems were associated with more favorable user

attitudes. Testa (1974) argued that different cognitive types of users were affected differentially by the mode of interface. Yet, a matching of the most effective mode to individual users was still in the experimental stage (Mason and Mitroff, 1973). This factor, therefore, varied in its influence on the user's satisfaction.

> <u>Convenience of access</u>: The ease or difficulty with which the user may act to utilize the capablity of the computer systems.

Before the potency of computer systems can be gainfully employed, the user must have access to that capability. The convenience of that access can influence the user's satisfaction. This convenience is affected by a multitude of factors. The location and number of terminals, the mechanical condition of keypunch machines, the policies and procedures for requesting new application development, or the open or closed status of the EDP center itself are examples of factors which affect the user's accessibility (Firnberg, 1973).

> <u>Accuracy</u>: The correctness of the output information.

> <u>Timeliness</u>: The availability of the output information at a time suitable for its use.

> <u>Precision</u>: The variability of the output information from that which it purports to measure.

> <u>Reliability</u>: The consistency and dependability of the output information.

> <u>Currency</u>: The age of the output information.

> <u>Completeness</u>: The comprehensiveness of the output information content.

The quality of the systems that support the user was often mentioned in the literature as a source of satisfaction or dissatisfaction. The preceeding attributes were cited as the primary indicators of quality. They appeared to be unidimensional in character. Some of the literature sources for each attribute are shown in parenthesis:

1. Accuracy (Stone and Tarnowieski, 1972)
2. Timeliness (Swanson, 1974)
3. Precision (Adams and Schroeder, 1973)
4. Reliability (Adams, 1975)
5. Currency (Lucas, 1973a)
6. Completeness (Schussel, 1974)

Adams and Schroeder (1973) found evidence that different users tend to discuss different attributes with varying intensity. They stated:

> One interesting phenomenon... noticed in talking with middle managers is their tendency to concentrate on one characteristic of the information that they receive to the exclusion of all others (Adams and Schroeder, 1973:65).

The multidimensional nature of the systems quality and the tendency of users to consider the dimensions differentially dictates that measurement of these factors provide for user weighting of each attribute. The weighting should reflect the differential effect of the attributes on the user's overall satisfaction.

Format of output: The material design of the layout and display of the output contents.

Adams and Schroeder (1973) reported that 20 percent of the managers they interviewed faulted the format for the

lack of desired data. The format of the output can facilitate or hinder the user's utilization of the information system, and hence, his satisfaction.

The attributes of clarity and summarization of the output products are included in this factor. Clarity reflects the ease of user comprehension of the output contents. Summarization reflects the levels of aggregation of data elements and their display. Both attributes are combined into the format factor as it affects user satisfaction.

> <u>Language</u>: The set of vocabulary, syntax, and grammatical rules used to interact with the computer systems.

The increased use of terminals, minicomputers, and distributed processing has fostered an increase in direct user-computer interface (Gruenberger and Babcock, 1973). The language that is used to facilitate this interaction has an effect on the user's satisfaction. Language refers to the key words and grammatical rules which allow the user to achieve his purpose. That purpose may be a database query, record update, data entry, or any of the others allowed under the capabilities of the particular system provided.

The user's satisfaction is affected by the clarity, versatility, and suitability of the language. Although this factor is most prominently mentioned in conjunction with on-line applications, it is not restricted to that situation. Language can also be an influence in batch-type applications

if the user is constrained to fixed grammers for utilization of his information systems.

> Volume of output: The amount of information conveyed to a user from computer-based systems. This is expressed by not only the number of reports or outputs but also by the voluminousness of the output contents.

Lucas (1974) found a strong negative correlation between the number of reports received and user attitudes. This sentiment was echoed by other authors (Fitts, 1971; Adams and Schroeder, 1973). Holmes stated:

> It is unbelievable under present-day concepts of exception reporting to find stacks of machine runoffs being delivered to senior executives. Sometimes the user finds the appropriate pages to keep, but more often all is discarded (Holmes, 1970:33).

The mechanisms for handling information overload were catalogued by Miller (1960):

1. Omission - the temporary non-processing of information.

2. Error - the processing of information incorrectly.

3. Queuing - the delaying of a response to catch up during a "lull".

4. Filtering - the neglecting of certain categories of information while processing others.

5. Cutting categories of discrimination - the responding to input in a more general way with less precision than before at slower rates.

6. Employing multiple channels - the processing of information through multiple channels, as demonstrated by

decentralizaton.

7. Escape from the task - the avoiding of processing any of the information.

A user who is forced to resort to one of these responses has reason to be dissatisfied with the information systems support. This factor not only includes the volume as a function of the number of reports, but also, as a function of the data or information included in a single output.

> <u>Relevancy</u>: The degree of congruence between what the user wants or requires and what is provided by the information products and services.

Gupta (1974) surveyed 150 large companies and discovered that not one of respondents was pleased with the development of their information systems. One of the primary causes of this dissatisfaction was the lack of relevancy of the output products to the concerns of the users.

In one sense, the relevancy of the information products and services provided is the crux of the effectiveness of the support rendered. Users cannot and will not use information that is not relevant to their functional requirements. This does not, however, preclude them from receiving irrelevant informaton.

> <u>Error recovery</u>: The methods and policies governing correction and rerun of system outputs that are incorrect.

Firnberg (1973) found that the ease of correcting errors was a source of user satisfaction in the case studies that he observed. This factor may be closely related to the Language factor and the scheduling policies for the EDP center. Systems which are subject to many source data errors coupled with stringent accuracy requirements, such as some accounting/finance functions, can be extremely frustrating to the user unless liberal rerun policies allow rapid error correction and output consolidation. Automated financial statements which require a zero-balance output is one example whereby the ease of error recovery can facilitiate user satisfaction.

Security of data: The safeguarding of data from misappropriation or unauthorized alteration or loss.

The sensitivity of the data may lead to user concern over the security of the data. Holland (1974) discovered that many users specified very narrow system designs to protect the accessibility of the data in their information systems. Firnberg (1973) found that the use of passwords and security codes to control access to data bases increased user satisfaction.

Security of data may also involve the physical security afforded by the EDP center itself. Theft, vandalism, and natural disasters, such as floods or fires, have been an increasing concern to some users (Parker, Nycum, and Oura, 1973). This concern has been reflected in the fortress type

design of some EDP centers and extensive backup facilities to ensure adequate recovery if accidents do occur.

The user's satisfaction is affected by the security of data, both in a system design sense and a physical safeguard sense. This factor becomes increasingly important as the sensitivity of the data increases, and users have their own different concepts of what constitutes sensitivity (Holland, 1974).

> Documentation: The recorded description of an information system. This includes formal instructions for the utilization of the system.

The documentation of an information system may affect the user in two ways. It may first influence the user's understanding of the system and facilitiate the utilization of that system. Secondly, the documentation may affect the actual processing of the system via the operating instructions. Failure to maintain the documentation properly and to reflect system changes can result in the incorrect execution of the system.

The existing documentation is often the initial basis for discussions between users and the EDP staff for new or improved system development (Smith and Wechsler, 1973). The quality of that documentation is an important source of user satisfaction or dissatisfaction.

> Expectations: The set of attributes or features of the computer-based information products or services that a user considers reasonable and due from the computer-based information support rendered within his organization.

Every user develops expectations about the capabilities engendered by computer technology. These expectations are altered in many ways by many sources: the user's colleagues, publications, vendor sales presentations, and the user's increasing experience and learning process are a few of the important influences. These expectations are satisfied or dissatisfied to a varying degree.

Dissatisfaction is often registered by users who claim that the computer capabilities were "oversold". The claim that the capabilities of the systems requested fell short of those advertised while the costs exceeded the budgeted amounts was repeated with regularity in the literature (Neuschel, 1971; Colton, 1973).

This factor may prove to be quite volatile as an influence on user satisfaction. Expectations may rise or fall rapidly with the occurrence of single events. One example would be a user's discovery of the existence of a powerful information system in a competitor's organization that is not provided in the user's own organization. Another example would be a user's introduction to the realities of the demands of software development. The user expectations may fall as the user learns of the time required for complex systems, yet rise with exposure to the capabilities which it affords.

> <u>Understanding of systems</u>: The degree of comprehension that a user possesses about the computer-based informations systems or services that are provided.

An increased understanding appears to generally lead to increased satisfaction for the user (Colton, 1973). The reverse may be true if the information system is of low quality with severe shortcomings. One reason for the effect of this factor may be that increased understanding reduces the user's feeling of dependency on the EDP staff and their knowledge of the system. This conjecture, however, has no quantitative support at this time.

> Perceived utility: The user's judgment about the relative balance between the cost and the considered usefulness of the computer-based informaton products or services that are provided. The costs include any costs related to providing the resource, including money, time, manpower, and opportunity. The usefulness includes any benefits that the user believes to be derived from the support.

Dearden and Nolan (1973:76) stated, "In our opinion, users should pay a fair price for the computer resources that they use. After all, the resource should serve a purely economic function for the user." Regardless of whether a direct method of payment was used (charge-back) or not, most writers agreed that users have an opinion about the utility of the information services they receive (Fitts, 1971; Swanson, 1974; Adams, 1975). In his study of police departments, Colton (1973:95) found that "the computer is viewed by some departments as being a nice but disposable luxury, and there is always the potential for waste."

The user's perception of the utility of the support carries beyond a sheer economic cost analysis. In some

functional applications, computer systems are considered vital to the success and even the existence of the organization. An example would be a banking application requiring massive data handling within severe time constraints to meet government regulations to maintain the bank's charter. Such utility perceptions influence the user's satisfaction with the information system support.

Confidence in the systems: The user's feelings of assurance or certainty about the systems provided.

The user's confidence in systems is applicable during both the developmental process and the system operation. The former signifies a belief that the EDP staff can and will deliver the system capability as agreed upon. The latter involves the quality and reliability of service of existing systems. Neuschel (1971:85) asserted, "No computer program will long be successful if there is no credibility and confidence between management and the systems and computer people."

Feeling of participation: The degree of involvement and commitment which the user shares with the EDP staff and others toward the functioning of the computer-based information systems and services.

A majority of the managers interviewed by Holland (1974) felt that users should be highly involved in the system design process. Tomeski (1974) elaborated upon that point in his study of job enrichment and the computer. Other writers agreed on the importance of participation (Dickson and Simmons, 1970; Holmes, 1970). This support for

user involvement was touted largely for its effect on the "success" of the resultant system. Yet, Tomeski (1974) effectively argued for the participation because of its effect on user satisfaction as well.

Participation, or lack of it, can have an effect on the user's understanding and confidence in the system. This factor can also influence the user's feeling of achievement, an important reinforcer of positive behavior. Both effects are registered in the user's satisfaction.

> Feeling of control: The user's awareness of the personal power or lack of power to regulate, direct or dominate the development, alteration, and/or execution of the computer-based information systems or services which serve the user's perceived function.

The importance of this factor was most strongly stated by Adams (1975:343) in the form of an hypothesis that "control over systems and systems development is a major factor in the satisfaction of management information systems users." This hypothesis was supported by data collected by Adams, as well as others (Diebold, 1969; Tatham, 1969; Fitts, 1971). It was considered a strong element of user satisfaction.

The user's feeling of control has several facets. It may concern budget control for new development, design change/initiation decision authority, scheduling control, or others. This factor may also be affected by organizational considerations. The degree of centralization of the EDP resources and staff, coupled with the EDP organizational

position, can modify the user's feeling of control.

> Degree of training: The amount of specialized instruction and practice that is afforded to the user to increase the user's proficiency in utilizing the computer capability that is available.

A survey conducted by Lucas (1973a) contained a provision for open-ended comments in the questionnaire on user attitudes. The second most common comment from the respondents was a desire for more training. The data also reflected a positive relationship between the amount of training and favorable attitudes among users. One reason for this relationship could have been the more realistic expectations coupled with increased understanding of the systems that one would expect to follow additional user training.

> Job effects: The changes in job freedom and job performance that are ascertained by the user as resulting from modifications induced by the computer-based information systems and services.

Two primary job effects induced by the use of computer-based information systems were cited in the literature (Holmes, 1970). The first was the effect on the user's sense of job freedom. One user could feel that the imposition of a structured information system was very restrictive. Yet, another user could feel that the use of an information system offered freedom from mundane, repetitive tasks and allowed concentration on the more interesting and unstructured aspects of the job.

The second job effect noted was the effect on the user's job performance. One consistent justification for

implementing computer-based information systems was to enable users to perform their jobs and make decisions more rapidly and more comprehensively (Lucas, 1974). These claims were justified for some users. Other users found that the positive effects on their job performance were insignificant in relation to the requirements imposed by the system. This resulted in a negative net effect on the user's job performance.

Independent Review

The literature review provided an extensive list of factors that influence a user's satisfaction. As a first step in validating the completeness of the list, the factors and their operational definitions were provided to three independent judges for review. The purpose of this review was to provide an independent assessment of the completeness of the list of factors. The collective experience of the judges augmented the literature review process and provided different perspectives to counterbalance any pertinent omissions that could have occurred.

The judges were selected on the basis of their experience in the data processing field and their history of formalized interaction with users and user groups. The first judge was the manager of a commercial data processing service bureau. The second judge was a university professor with a varied background which included extensive experience

as a consultant for data processing and organizational problems. The third judge was the manager of a major university's data processing center. He had previous experience in a similar position with a large industrial organization. The third judge had two of his assistants aid him in the review process; therefore, a total of five persons actually reviewed the list of factors.

Each judge was asked to review the list of factors and the definitions and to comment on any omissions or definitional shortcomings. These reviews were conducted in an unstructured format. Collectively, the judges considered the list to be more extensive than expected and expressed difficulty in finding omissions. Notwithstanding the favorable reviews by all of the judges, two factors were suggested for inclusion on the list. These factors were added to the list and are shown below with their operational definitions:

> <u>Organizational Position of the EDP Function</u>: The hierarchical relationship of the EDP function to the overall organizational structure.
>
> <u>Flexibility of Systems</u>: The capacity of the information system to change or to adjust in response to new conditions, demands, or circumstances.

The suggested additions and the independent assessment of the completeness of the factor list indicated that the important factors that influence a user's satisfaction with computer-based information products and services had been

identified. An empirical test of this concept and a formalized definition of importance was then designed and conducted to further validate the claim of completeness. The test design and test results appear in the following sections.

EMPIRICAL TEST OF THE FACTOR LIST

The factor list illustrated in Table 3.3 was compiled to establish the fundamental dimensions for measuring user satisfaction. The objective of this phase of the research was to test the completeness of the list of factors. A formal restatement of this objective is developed below.

Let U denote the universal set of all factors which influence a user's satisfaction. The set U is assumed to be finite but unknown. Let F denote the subset of U expressed by the factors in Table 3.3. The element x signifies any factor that a randomly selected user considers important as an influence on his state of satisfaction. The claim that F is a sufficiently complete list of important factors is determined by the probability of x being a member of F. Specifically, the subset F is defined to be sufficiently complete if the probability of x being an element of F is greater than .90, which may be restated as:

$$\Pr (x \in F) > .90 \quad (3.1)$$

This definition is based on the rationale that important factors tend to be shared by many users. Although each individual user may specify a unique set of factors which

Table 3.3

Factors Affecting User Satisfaction

Factor	Category
Top management involvement	Organizational Context
Organizational competition with EDP unit	
Priorities determination	
Charge-back method of payment for services	
Organizational position of the EDP function	
Relationship with the EDP staff	EDP Center Staff, and Policies
Communication with the EDP staff	
Technical competence of the EDP staff	
Attitude of the EDP staff	
Schedule of products and services	
Time required for new development	
Processing of change requests	
Vendor support	
Response/turnaround time	Interface
Mode of interface	
Convenience of access	
Accuracy	Quality of Systems
Timeliness	
Precision	
Reliability	
Currency	
Completeness	
Flexibility	
Format of output	
Language	
Volume of output	
Relevancy	
Error recovery	
Security of data	
Documentation	
Expectations	User Constructs
Understanding of systems	
Perceived utility	
Confidence in systems	
Feeling of participation	
Feeling of control	
Degree of training	
Job effects	

influence satisfaction, the important factors will be cited with greater frequency over the entire population of users. If the probability condition of Equation 3.1 is true, then at least 90 pe[illegible]f the factors which affect the satisfaction of any [illegible] selected user is expected to be contained in the set [illegible]nsequently, the set F forms a sufficient domain for measuring the critical content of any user's satisfaction construct.

The completeness of F may be verified by a test of the probability of any factor x being included in F. The identification of a factor by a user is an event which can have one of two mutually exclusive outcomes. The factor is either a member of F, or it is not. Therefore, each factor identified by a user may be regarded as an independent Bernoulli trial.

A test based on the binomial distribution was used to evaluate the completeness of F. The test was conducted in the following manner:

1. The set F was defined by the factors in Table 3.3.
2. A representative sample of users was selected.
3. Each user was subjected to an interview process designed to elicit the factors which influence the user's satisfaction.
4. Each factor that was mentioned was extracted from the interview.

5. Each factor was labeled a success (was an element of F) or a failure (was not an element of F).

6. Each mention of a factor was regarded as an independent trial.

7. The test statistic was calculated from the frequencies of successes and failures based upon a binomial distribution with a probability of success of greater than .90.

The null hypothesis for this test was:

$$H_0 : Pr(x \varepsilon F) \leq .90$$

The alternative hypothesis, which could be accepted if H was rejected, was:

$$H_1 : Pr(x \varepsilon F) > .90$$

The use of a test based on a binomial distribution must satisfy four assumptions (Bradley, 1968:166):

1. Outcomes must be capable of being dichotomized.

2. The two outcomes must be mutually exclusive.

3. The outcome of the events must be independent. This means that the probability of "success" must not change from trial to trial.

4. Events must be randomly selected.

The first two assumptions were easily satisfied because each factor x was either contained in F or not contained in F; thus, the outcomes were dichotomized and mutually exclusive. The assumption of independence between trials was not strictly satisfied. The assumption that each factor mention

was an independent trial was based on the presumed lack of correlation between factors. Thus, the existence of a positive correlation between two factors would imply that the mention of one factor could increase the likelihood of the second factor being mentioned. If both factors were elements of F, the mention of one factor could increase the probability of the second factor being mentioned, and subsequently, being an element of F as well.

Casual examination of the factors included in F suggested that several factor pairs were probably correlated. Some examples included Reliability and Confidence in systems or Understanding of systems and Degree of training. The correlation between factors could change the probability of a factor being mentioned; yet, no claim was made that each factor in U was equally likely to be mentioned. Rather, the concern centered on the probability of a factor mentioned being an element of F or not. Therefore, each individual mention of a factor was treated as an independent trial which resulted in success or failure.

The assumption of the random selection of events was also not strictly achieved. Ideally, the random selection of events should have been made from the population of all factor mentions of all users. Clearly, this was impossible within the constraints of any reasonable research. Instead, an attempt was made to select a representative user group under certain randomizing conditions. The set of factors

mentioned by these users was assumed to comprise a random selection of events. The sample selection procedure and randomizing conditions appear in the following section.

Sample Selection Process

The limitations imposed by organizational access and economy of resources precluded the selection of a truly random sample. Therefore, a representative sample was employed to include a variety of functional users from different types of organizations. In order to codify the test data, the following taxonomy was used.

Eight organizational categories were selected, and a local organization for each category was identified. The majority of the categories was selected from those used by Datamation, a computer trade journal, for survey studies (McLaughlin, 1976). These were augmented by other categories which included significant user groups. The categories of organizational types represented in the sample were:

1. Academic
2. Banking
3. Hospital
4. Manufacturing
5. Military
6. Retailing
7. State Government
8. Utility

Seven functional areas were identified for the purpose of user selections within the organizations. These functional areas were:

1. Accounting
2. Administration
3. Finance
4. Marketing
5. Operations
6. Personnel
7. Planning/Budget
8. Other__________ (supplied by the user subjects)

No attempt was made to rigidly require that a user fit purely into a single functional area. The user subjects were asked to identfy all of the functional areas, including any not specified, that were applicable to their present job position.

Within these bounds established for a representative sample, an attempt was made to randomize the selection as much as possible. Each organizational category and each functional area were assigned a single alphabetic character and a digit, respectively. A pairing of the functional areas to the organizational categories was performed using random digits selected arbitrarily from a table of random numbers (Selby, 1973:630). Thirty such pairings were made. The previously identified local organizations were then contacted to supply the name of a user subject matching the

functional area that had been randomly assigned.

The individual who was contacted for each organization was given the liberty to provide names of users who did not match the requested functional areas. Several contacts did recommend and provide names of users whose functions they felt were more appropriate for their organization. Three organizational contacts provided more than the number of names requested. These additional names were included in the sample. A total of 33 users was identified.

Therefore, the sample was randomized in two ways. The first was by the randomized pairing of the functional areas and the organizational category. The second was by the independent subject selection within the organization. Typically, each organization had several users who could have been selected from a given functional area. The person contacted in conjunction with an organization selected the subject from that group independently.

Each subject identified in the above manner was contacted via a letter and asked to participate in the research project. The cover letter is shown in Appendix 3.2. Only one of the subjects, B2, declined the request. Those not declining were contacted by telephone to arrange an appointment for an interview.

Each subject was asked to complete a brief background form before the interviews were conducted. The form also

included a consent statement in which the subject acknowledged that participation was voluntary and that permission to record the interview was granted. All of the subjects completed the form and signed the consent statement. The blank form is shown in Appendix 3.3.

A distribution of the subjects by functional position, experience level, type of output interactions, and level of usage is shown in Table 3.4. The background form to derive this distribution was deliberately short and easy to complete. This data was of secondary interest, and the collection was limited to prevent any detraction from the interview process itself.

The distribution of the subject sample supported the contention that a representative sample was achieved. In addition to the seven primary functional areas, eight more areas were identified by subjects in the Other category. Therefore, a total of fifteen functional areas in eight different organizational types were included. The great majority of the users considered themselves heavy users and had a great deal of experience (over six years). This was expected from the manner of selecting the sample. Most organizational contacts tended to identify the major users of the EDP resource as the primary candidates for inclusion in the sample.

The middle management restrictions on the user population tended to identify users with more experience than

Table 3.4

Sample Distribution

Background Data	Category	Number of Subjects
Functional job description*	Accounting	13
	Administration	8
	Finance	6
	Marketing	3
	Operations	11
	Personnel	6
	Planning/budget	8
	Other**	8
Experience using EDP support	0 - 3 years	4
	4 - 6 years	4
	over 6 years	24
Type of output mode	Hard copy	32
	Terminals	21
	Microforms	19
User EDP utilization classification	Heavy	24
	Medium	4
	Light	4

* Subjects were asked to check all functional areas included in their present job position.

** Other functions listed were (1) Maintenance, (2) Payroll, (3) Patient Services Receivables, (4) Management/ Operation Analysis, (5) Manufacturing, (6) Operations Research, (7) Materials Management, (8) Product Distribution.

perhaps a completely random sample of all users would have achieved. The preponderance of heavy, experienced users, however, increased the number and types of critical incidents that could be discussed during the interview process. There was ample representation of the three primary modes of output available to the user subjects.

Therefore, the sample of users was considered both representative of and randomly selected from the overall user population of interest. This conclusion was based on the cross-section of organizational types and functional job positions included in the user sample. The selection of the specific users was performed both independently and under randomizing conditions.

<u>Interview Procedure</u>

The purpose of the interviews with the user subjects was to elicit factors which they deemed important as influencing their state of satisfaction or dissatisfaction. Three basic methods could have been utilized to draw out these factors (Herzberg, Mausner, and Synderman, 1959).

The first method was the presentation of a list of factors previously determined by the investigator. This procedure was subject to several distorting forces. The subject could try to please the investigator by rating factors highly that were perceived to be of high social acceptance rather than factors which were personally

important. The subject could also react with bias toward a listing of factors assembled by "experts" and fail to respond with pertinent factors which were not included on the list.

A second method was to simply ask the subject to list and rank factors which were personally important. This direct approach was subject to the same halo effect inducement of the first method. Moreover, the subject could simply forget pertinent factors without a proper stimulus.

A third method which utilized critical incidents was adopted for this interviewing procedure. The critical incident technique was used with great success by Herzberg, Mausner, and Synderman (1959) in developing the two-factor theory of job satisfaction. Content analysis of critical incident interviews also played an integral role in the development of the Job Descriptive Index, a measurement instrument for job satisfaction (Smith, Kendall, and Hulin, 1969). In describing the development of the critical incident technique, Flanagan stated:

> It should be emphasized that the critical incident technique does not consist of a single rigid set of rules governing data collection. Rather it should be thought of as a flexible set of principles which must be modified and adapted to meet the specific situation at hand (Flanagan, 1954:335).

The critical incidents for this research were those situations in which a subject felt particularly satisfied or dissatisfied with the computer-based information products

and services that were received at any time during the user's working career. By asking the subject to describe such incidents and by using neutral probes, a more reliable set of factors was obtained. It was observed that the distortions affecting the first two methods of eliciting factors were "markedly less operative when a respondent was talking about actual events" (Herzberg, Mausner, and Synderman, 1959:15). It was assumed that any factor mentioned by a user while discussing a critical incident was important to that user.

The descriptions of the critical incidents by the subjects were probed in a semi-structured manner. Since the subject was given freedom to select his events, the investigator was forced to probe in a manner that was consistent with these descriptions in order to secure the pertinent information. A complete interview guideline with suggested probes is included in Apppendix 3.4.

The interview procedure was pre-tested to determine the effectiveness of the probes and the clarity of the instructions. As a prelude to the actual interviewing process, the Interviewer's Manual published by the Survey Research Center at the University of Michigan (1969) was extensively studied. Several other references on interviewing techniques were consulted to alleviate any lack of interviewing experience (Adams, 1958; Cannel and Kahn, 1968; Converse and Schuman, 1974; Dexter, 1964; Hyman, 1954; Yates, 1975).

Four test subjects (not included in the sample group) were interviewed using the guidelines and suggested probes. Following the interview, each subject was asked to evaluate the interviewing process. All of the test subjects expressed extremely favorable reactions to the interview technique. Three of the subjects stated that they "forgot" that it was being taped during the interview. The unstructured format and the use of critical incidents seemed especially effective in stimulating the subjects' recall.

One test subject was asked to estimate the number of factors that he had mentioned during his interview. His estimate was 12 factors; yet, a joint review of the interview recording revealed 31 factors mentioned by the subject. During the replay of the interview, the subject expressed surprise at many of the factors that he had mentioned in describing certain incidents. This exchange strengthened the confidence that the critical incident technique was appropriate for this data collection purpose.

Data Extractions

The interviews were recorded on cassette tape after obtaining permission from the subject. No subject declined to have the interview recorded. An analysis of the recorded interviews was used to extract the "thought units" from the interview statements. Herzberg, Mausner, and Synderman (1959:38) defined a thought unit as "a statement about a

single event or condition that led to a feeling, a single characterization of a feeling, or a description of a single effect." Some examples of thought units selected at random from the interview recordings are:

1. "If we have problems in getting those problems solved, or getting a solution or change to a program, an alteration of any type, it is like an act of Congress to get it done."

2. "We just do not have the control that we had before."

3. "The only thing you run into, as far as a problem, is the currency of information that is on the file."

4. "I think that what has been lacking is user participation."

5. "I think that we have created a lot of programs that have yielded very little useful data."

6. "There is a lack of understanding of the products that we receive, and really the overall system, within the users, particularly the mid-level managers."

Each of these thought units expressed a factor which influenced the subject's satisfaction. The exact procedures for the factor extraction process were included in a syllabus developed to standardize the methodology. The syllabus is shown in Appendix 3.5. The procedural steps of the syllabus are listed in Figure 3.2.

1. Listen to the entire tape and concentrate on recognizing thought units as they are expessed by the respondent.

2. Rewind the tape.

3. Again, listen to the tape, but stop anytime that a thought unit is expressed.

4. If the factor expressed by the thought unit is clear, write down the factor directly. If the factor is not clear, write down the thought unit verbatim.

5. Evaluate the thought unit before proceeding with the tape. However, a short portion of the interview beyond the thought unit in question may clarify it. Decide on a factor that the thought unit expresses and write it down.

6. Proceed with the tape and repeat steps 3-5 until the interview portion is completed.

7. Divide the list of factors that were extracted from the tape into two groups. Those factors that were defined in Part III of this syllabus are listed in the first group using the nomenclature as defined. The second group of factors contain those factors not defined in this syllabus. The nomenclature of these factors must be devised to convey understanding about the undefined factors. Duplicate factors are listed only once in the final two groups.

8. This completes the data extraction.

Figure 3.2

Syllabus Procedures for Interview Evaluations

One weakness in the procedure was that the investigator performed all of the interviews and extracted all of the factors for each subject. There were no factors intentionally mislabeled, however, to conform to the a priori list of factors proposed by the investigator. The potential for judgmental bias did exist, and a simple test to evaluate the strength of that bias was performed.

A test subject's recording was selected for the evaluation. A test subject was used instead of a sample subject to protect the confidentiality that had been promised to each sample subject. The test subject's permission was obtained prior to the use of the interview recording for this purpose.

Four judges were selected, and each judge was given a copy of the syllabus for data extraction and instructed on its use. The interview recording and cassette player was provided to each judge, in turn, to perform a data extraction. In addition, the investigator performed a data extraction from the recorded interview. There was no communication between the judges about the results which they obtained until all had been collected by the investigator.

A comparison of the results is shown in Table 3.5. Each factor identified by either the investigator or one of the independent judges is listed in the factor set. The factors extracted by the investigator are signified by an

Table 3.5

Data Extraction Comparison

Factor	Judges					Composite	
	1	2	3	4	5	1	2-5
Priorities determination	X	X	X	X	X	X	X
Organizational position of EDP function	X	X	X			X	X
Relationship with the EDP staff	X	X	X	X	X	X	X
Communication with the EDP staff	X	X	X	X	X	X	X
Technical competence of the EDP staff	X		X	X	X	X	X
Attitude of the EDP staff	X		X	X	X	X	X
Schedule of products and services	X	X	X	X		X	X
Time required for new development	X	X		X	X	X	X
Processing of change requests	X	X	X	X	X	X	X
Response/turnaround time	X	X	X	X	X	X	X
Mode of interface	X	X	X		X	X	X
Convenience of access	X		X	X	X	X	X
Accuracy	X	X	X		X	X	X
Timeliness	X	X	X			X	X
Precision					X		X
Reliability	X		X	X	X	X	X
Currency	X		X	X		X	X
Completeness	X	X	X	X		X	X
Flexibility	X	X	X	X	X	X	X
Format of output	X				X	X	X
Language	X		X	X		X	X
Volume of output	X	X		X		X	X
Relevancy	X	X	X			X	X
Error Recovery	X	X	X		X	X	X
Documentation	X				X	X	X
Expectations	X		X		X	X	X
Understanding of systems	X		X	X	X	X	X
Perceived utility			X		X		X
Confidence in systems	X	X	X	X	X	X	X
Feeling of participation	X	X	X	X	X	X	X
Feeling of control	X	X	X	X	X	X	X
Degree of training	X		X			X	X
Job effects	X	X	X	X	X	X	X
Continuity of EDP staff*	X	X			X	X	X
Long term trend of improvement*					X		X
Increased feeling of professionalism*,**			X				X

*   Factor not included in F

** Judge 3 was undecided if this was a separate factor or one aspect of the Job effect factor.

"X" in column one. The factors extracted by the independent judges are similarly identified in columns two through five. A composite comparison contrasts the factors identified by the investigator with the pooled set of factors identified by the independent judges.

The results illustrated in Table 3.5 indicated that independent judges may reach some different conclusions about the factors discussed by a subject. However, there was a strong tendency of judges to agree on most factors. There were 36 factors mentioned by at least one judge. The mean number of judges extracting the same factor was 3.6 (maximum was 5.0). A complete comparison between each pair of judges on the factor set indicated that perfect agreement between each pair of judges would have resulted in 360 matches. There were 232 matches achieved. Based on these frequencies for this sample, the percentage of agreement was 64.4 percent. If all five judges had identified each of the 36 factors, there would have been 180 identifications. There were 129 identifications for a rate of 71.7 percent. This indicated that an average of 71.7 percent of all judges identified the individual factors of the factor set.

A comparison of the factor set identified by the investigator with the composite set of factors identified by the four independent judges revealed 32 matches and only 4 mismatches. The investigator did not extract a single factor that was not identified by at least one of the independent

judges. The composite comparison is also illustrated in Table 3.5.

This independent extraction comparison supported the assumption that, although there would be some inter-judge disagreement on the factors contained in an interview recording, the factors identified by the investigator would not differ significantly from those identified by independent judges utilizing the data extraction syllabus. The extensive amount of time required of the judges to perform the data extractions precluded a more comprehensive test of this assumption.

Test Results

The data to test the hypotheses were collected after the interview and data extraction procedures were developed and evaluated. Thirty-two sample subjects were interviewed. The factors were extracted from each interview in accordance with the procedures outlined in the syllabus. Each subject was provided with a list of the factors extracted only from his interview. Operational definitions of each factor were also provided. The subjects were asked to rank each factor in order of importance as an influence on their state of satisfaction or dissatisfaction. Only one subject, B3, failed to rank the factors. The factors mentioned by each subject and the subject rankings of those factors in order

of importance are shown in Appendices 3.6 and 3.7, respectively.

The total number of factors mentioned by the subjects was 638. The number of factor mentions per subject ranged from 15 to 31 with an average of 19.9 factors per subject. Only 13 of the 638 factor mentions were not included in F. Therefore, 625 of the factor mentions were designated as "successes" and 13 were designated as "failures". Due to the large number of trials, n = 638, a normal approximation of the binomial distribution, corrected for continuity, was used to calculate the test statistic. A restatement of the hypotheses is presented below:

$$H_0 : \Pr (x \in F) \leq .90$$
$$H_1 : \Pr (x \in F) > .90$$

The "critical" or rejection region was defined as any z statistic greater than 2.327 for a level of significance of .01. The z statistic for 625 successes out of 638 trials, corrected for continuity, was 6.768. Since this value exceeded 2.327, the null hypothesis was rejected, and the alternative hypothesis

$$H_1 : \Pr (x \in F) > .90$$

was accepted. Therefore, it was concluded that the domain of the user satisfaction construct was defined by the factors contained in the subset F. This conclusion was supported at the .01 level of significance.

The rankings of the factors by the user subjects were also revealing. The frequency of mentions, minimum rank, and maximum rank for each factor are shown in Table 3.6. The "average" rank for each factor is also shown. Care must be exercised in any interpretation based upon this "average" because it is a mechanical average based strictly on ordinal data. True "means" require interval data. The average rank was calculated only to give a "feel" for the ranking distribution for each factor.

The user rankings dramatically underscore the assumption that different users differ widely in their perception of the importance of different factors. Eighteen of the 38 factors contained in F were ranked first in importance by at least one subject. Only 3 of the 38 factors had a minimum rank greater than 10. Yet, the maximum ranks for each factor was not less than 12, with 24 of the factors having maximum ranks greater than 20. These wide ranges of ranks assigned to the factors supported the assumption that users differentiate substantially in the order of importance of the individual factors.

The factor rankings of the factors not contained in F singled out one factor for additional consideration. Integration of systems was mentioned by four subjects and ranked 2, 2, 7, and 17 in importance. The significant combination of frequency of mentions and high overall rankings provided evidence that F should be expanded to include this factor.

Table 3.6

Distribution of Factor Rankings

Factor	Frequency	Minimum	Maximum	Average
Top management involvement	5	1	22	12.4
Organizational competition with the EDP unit	4	11	30	19.5
Priorities determination	23	2	22	9.0
Charge-back method of payment for services	3	14	19	18.0
Organizational position of the EDP function	10	4	24	15.2
Relationship with the EDP staff	22	1	29	11.5
Communication with the EDP staff	23	1	22	11.3
Technical competence of the EDP staff	22	1	27	8.2
Attitude of the EDP staff	21	2	25	9.7
Schedule of products and services	13	9	19	13.8
Time required for new development	20	1	19	10.0
Processing of change requests	27	5	22	11.3
Vendor support	6	14	28	19.8
Response/turnaround time	17	1	18	9.1
Mode of interface	25	8	21	15.0
Convenience of access	17	1	19	9.1
Accuracy	23	1	16	6.1
Timeliness	15	1	17	6.3
Precision	4	1	12	8.0
Reliability	15	1	18	6.4
Currency	11	1	13	8.5
Completeness	23	1	23	6.9

Table 3.6 (continued)

Factor	Frequency	Minimum	Maximum	Average
Flexibility	17	2	14	5.8
Format of output	15	3	23	14.1
Language	7	10	24	17.3
Volume of output	11	6	25	16.6
Relevancy	22	1	17	7.2
Error recovery	9	3	17	9.0
Security of data	6	8	20	15.0
Documentation	13	4	21	10.8
Expectations	22	7	24	15.0
Understanding of systems	21	1	22	11.5
Perceived utility	24	2	24	10.7
Confidence in systems	11	1	16	6.9
Feeling of participation	17	1	26	10.8
Feeling of control	20	2	23	12.7
Degree of training	12	5	22	12.3
Job effects	28	1	22	12.3

Although this expansion was unnecessary to satisfy the statistical criteria that had been established, the judgment that F was improved by including this factor prevailed. The operational definition was formulated as follows:

> Integration of systems: The ability of systems to communicate/transmit data between systems servicing different functional areas.

This expansion extended the number of factors in F to 39. The overall conclusions are presented in the following section.

SUMMARY

The objective of this research phase was the identification of a subset of factors that form the content domain of the user satisfaction construct. Thirty-eight factors were identified via a literature review and an independent assessment by a group of expert judges. A representative sample of 32 users was interviewed to elicit factors important to their satisfaction state. The data extracted from the interviews formed the basis of an empirical test of the completeness of the factor list. The test results established that the domain of the user satisfaction construct was defined by the factors contained on the list at the .01 level of significance. One additional factor was added to the domain because of the high importance rankings it achieved. The probability exceeded .90 that a factor considered important by a user was contained in the domain

as defined.

These 39 factors are listed in Appendix 3.8. Each factor was designated as F_i, $i = 1$ to 39, for the remainder of this study. The factor listing is provided on a fold-out sheet for the reader's convenience. The definitions are also given.

The results of this chapter established the domain of the user satisfaction construct and provided the fundamental basis to answer the question of "what" to measure to indicate the state of an individual user's satisfaction. The next chapter traces the development of the measurement instrument which combines the domain definition with the semantic differential methodology.

Chapter 4

CONSTRUCTION OF THE MEASUREMENT INSTRUMENT

The construction of the measurement instrument integrates the domain of the user satisfaction construct with the semantic differential methodology. The domain consists of those factors identified in Chapter 3 which influence user satisfaction. The semantic differential methodology presented in Chapter 2 requires that scales, defined by pairs of bipolar adjectives, be constructed for each factor. The selection of appropriate adjective pairs to anchor opposite poles of the evaluation continuum for each factor is critical to the measurement process.

The selection procedure to identify bipolar adjective pairs for the specific scales is described in this chapter. The procedure, conducted in concert with five university professors, results in the formulation of four evaluation scales for each user satisfaction factor. These four scales are augmented by an internal consistency scale and an importance weighting scale to operationalize the measurement of a user's feeling toward each factor.

The second portion of this chapter centers on the decisions of format that influence the effectiveness of the measurement instrument. These decisions lead to the initial assembly of the instrument in booklet form with appropriate instructions for completion. A preliminary evaluation of

the instrument by a sample group of users establishes that the instrument and instructions have the desired characteristics of clarity, brevity, and visual appeal.

The completed measurement instrument described in this chapter provides a means to measure user satisfaction. A complete copy of the instrument is presented in Appendix 4.1.

SELECTION OF SCALES

The scales of a semantic differential measurement instrument are defined by bipolar adjective pairs which describe the concept or factor that is to be measured. The initial step in the construction of a user satisfaction measurement instrument was the selection of adjective pairs for each of the 39 factors identified in Chapter 3 as the construct domain.

The selection procedures employed in other studies typically utilized only adjective pairs from the original thesaurus study by Osgood. Coyne and Holzman (1966:665) commented, "Too often investigators cull items from the Osgood, Suci, and Tannenbaum (1957) book without pretesting their relevance or their factor structure for the concept they wish to measure." The effect of this practice was described by Lusk:

> By selecting adjectives based solely upon Osgood's thesaurus study, a high preponderance of mid-interval (neutral) responses may be evidenced indicating an inapplicable concept/adjective pairing (Lusk, 1973:202).

Lusk, however, followed this observation with a recommended selection procedure that depended directly on the use of adjective pairs from Osgood's study. The procedure utilized a sample of individuals representative of the subject population of interest. The semantic responses of the sample group were used to calculate the variance from the midpoint for each adjective pair (selected from Osgood's study) for the measurement concepts. The adjective pairs with the largest variance were then selected to form the measurement instrument.

A factor analysis procedure was employed by Summey (1974) to select adjective pairs. He first selected adjective pairs which were identified by interview descriptions of the concepts to be measured. This set of adjective pairs was then administered to a pretest subject group. The responses were subjected to a factor analysis, and the adjective pairs receiving the highest loadings on the desired semantic space dimensions were selected for the measurement instrument.

The adjective pairs for the user satisfaction instrument were selected to satisfy three criteria:

1. Factorial composition
2. Relevance

3. Semantic stability

The factorial composition was intended to be unidimensional with all adjective pairs denoting the Evaluation dimension. Each adjective pair was to be relevant to the specific factor that it measured. Finally, semantic stability required an unambiguous polarity for each adjective pair. The selection procedure described in the following section was designed to satisfy the specified criteria and to minimize any bias or lack of perception which might exist in the selections of a single investigator.

Selection Procedure

A two-step, Delphi type procedure was used to select the adjective pairs for the user satisfaction instrument. Five university professors and the investigator participated in this phase of the research. The rationale for the use of these individuals was two-fold. First, each had a background of involvement in EDP activiites. Secondly, it was felt that the academic experience suggested a language fluency that would be beneficial in the selection of appropriate adjectives.

Preparation for the selection procedure involved two preliminary actions. The first was the formulation of stimulus phrases that were indicative of the individual factor definitions. Since the factor name did not, in all

cases, convey the precise meaning contained in the definitions, the name was "extended" to impart the intended semantic stimulus. The more explicit phraseology aided the judges in devising and selecting appropriate adjective pairs for each factor.

The second preliminary action was the determination of the desired number of adjective pairs to be selected for each factor. Brown (1958) and Heise (1970) reported that four scales had conventionally been used for the Evaluation dimension measurements. Lusk observed:

> A rule of thumb is that more than 10 bipolar adjectives per concept may distract the respondent introducing a degree of arbitrariness in the subject's response. Therefore, if all three factor dimensions (Evaluative, Potency, and Activity) are to be measured, a mix of adjectives in the ratio 4 : 3 : 3 is not uncommon (Lusk, 1973:203).

In addition to historical convention, Heise (1970) found that adequate sensitivity (ability to discriminate between individuals) was achieved with four scales per dimension. The results of a study by Norman (1959) indicated that the greatest reliability gain over single scale ratings was attained by averaging three or four scales. He also noted that stability did not significantly increase when more than four scales (up to eight scales in his study) were used for a single concept. The decision to use four adjective pairs per factor was made cognizant of these results.

The choice of four scales per factor was also influenced by the time required of the subjects. Osgood, Suci, and Tannenbaum (1957) and Heise (1970) observed that subjects could make approximately 400+ ratings per hour. It was felt that an upper bound of subject time to complete the instrument should not exceed 30 minutes (or 200 scale ratings). This judgment was based upon subject behavior that was observed during the interview process and cautions expressed in the literature (Babbie, 1975). The use of four scales for 39 factors required 156 ratings by the subject which was within the upper bound.

The first step of the selection procedure required each judge to independently propose four adjective pairs for each factor that could be used to evaluate the individual factors. Each judge was provided a list of the 39 user satisfaction factors (with extended phraseology) and instructions for adjective pair specification. The complete set of instructions is contained in Appendix 4.2.

The judges were also provided a sample list of 50 adjective pairs that had been used in previous studies utilizing the semantic differential (Nunnally, 1961). These were provided only as a guide. The instructions explicitly required that adjective pairs be selected that were highly germane to each factor with a clear polarity of "goodness" or "badness". Pairs not found in the sample list were encouraged where appropriate.

The specified adjective pairs from the judges and the investigator were grouped by factor and redistributed to the judges. A new set of instructions, shown in Appendix 4.2, directed the judges to select the best four pairs from the set for each factor. The instructions also called for each judge to indicate the "positive pole" of each selected adjective pair. The "positive pole" identified the single adjective of a pair that described a good or satisfactory state for the specified factor.

The adjective pairs were rank-ordered by the number of judges selecting them. The four pairs designated by the greatest number of judges were selected for the user satisfaction measurement instrument. The investigator decided all ties. Any adjective pair that did not have complete agreement on polarity was automatically discarded. Disagreement was regarded as an indicator of semantic instability, a violation of the selection criteria. Only one adjective pair was eliminated for this reason. The adjective pairs selected by this procedure are shown in Appendix 4.3.

Weighting Function Scale

In addition to the four adjective pairs selected to evaluate each factor, a scale defined by the adjective pair "important - unimportant" was used to indicate the importance of each factor to the subject. The same response

categories were used for each scale. The use of a separate, but similar format, scale for importance was successfully employed by Friedlander (1965) and Mobley and Locke (1970).

Internal Consistency Scale

The adjective pairs were selected to evaluate a subject's feelings of satisfaction toward distinguishable factors. Homogeneity would be evidenced by high intercorrelations between the scale ratings measuring a particular factor (Robinson, Rush, and Head, 1974). An additional scale was included to provide another measure of the internal consistency of the instrument. The scale was defined by "satisfactory - unsatisfactory". This scale was included with the evaluation scales and the weight function scale for each factor to allow an item by item comparison as well as a factor score comparison with a "direct" assessment of satisfaction. The organization of scales into a completed instrument is discussed in the following section.

FORMAT OF THE INSTRUMENT

The selection of the adjective pairs to form the individual scales for each of the 39 user satisfaction factors finalized the content portion of the measurement instrument. The physical arrangement of this content for presentation to the subject groups involved specific questions of format. Babbie noted:

> The format of a questionnaire can be just as important as the nature and wording of the questions asked. An improperly laid out questionnaire can lead respondents to miss questions, can confuse them as to the nature of the data desired, and, in the extreme can lead to respondents throwing the questionnaire away... As a general rule the questionnaire should be spread out and uncluttered. The researcher should maximize the "white space" in his instrument (Babbie, 1975: 111).

The effect of "spreading out" the content of a questionnaire is an increase in the number of pages required for the same content expressed in a compressed format. Although this effect gives the general appearance of a longer, more time demanding questionnaire to the subjects, experienced researchers report that questionnaires with clear, uncluttered formats are more favorably received by respondents than shorter (fewer pages) questionnaires with more cluttered formats (Oppenheim, 1966).

A study conducted by the Survey Research Center of Arizona State University supported this finding (Axelrod, 1976). The study utilized two formats. One employed a compact matrix response space (a very crowded format) contained on both sides of a single page. The other format was the same content, spread out with individual response spaces, contained in a 26 page booklet. The two questionnaires were distributed randomly to the subject group. Only 44 percent of the single page questionnaires were returned, while 76 percent of the booklet-type questionnaires were completed and returned.

The higher response rate was attributed to two primary reasons. The first reason was easily detected. The booklet format reduced subject confusion and allowed a more rapid completion rate even though more pages were involved. The physical act of page-turning apparently positively reinforced a subject's sense of progress. In contrast, the single page format discouraged subjects by the lack of periodic "tangible" evidence toward completion.

The other reason for the higher completion rate was not so obvious. Follow-up interviews revealed that a subject's commitment to complete the questionnaire varied in direct proportion to the time spent in constructing the questionnaire, as evidenced by the physical appearance. Therefore, a questionnaire that appeared "thrown together" was lightly regarded by the subjects; e.g., an attitude of "If the investigator does not care, why should I?". Although the study results were not codified, one general principle did emerge. Subjects did tend to attribute importance to the questionnaire and the research that it represented on the basis of the physical appearance of the questionnaire.

Therefore, three fundametal tenets guided the material arrangement of the user satisfaction measurement instrument. These tenets were:

1. The content was to be unconstricted with ample "white space".

2. The responses required of the subjects were to be clear, simple, and rapid.

3. The total design was to reflect deliberate forethought to achieve a "professional" appearance.

Within these basic guidelines, the following aspects of the format were specificially addressed:

1. Number of scale intervals
2. Choice of adverb modifiers
3. Order of the scales
4. Order of the factors
5. Instruction set
6. Assembly

Number of Scale Intervals

The instrument scales were formed by the separation of the adjective pairs by a number of equal intervals which represented response categories. Traditionally, seven intervals were used in research employing the semantic differential (Heise, 1969). Miller (1956) argued in support of this tradition that subjects appeared to be limited in unidimensional judgments to about seven categories. Gulliksen (1958) challenged that viewpoint and stated that 20 - 30 point scales were feasible for semantic differential judgments. Garner (1960) confirmed that discrimination did increase as the number of rating categories increased, but Bass, Cascio, and O'Conner (1974) reported that an increased

number of rating categories was also accompanied by an increased overlap in adjacent point judgments. This overlap was as high as 44 percent for a 9 point scale.

The evidence was contradictory. The increased discrimination achieved by the use of many response categories was somewhat offset by the overlap of adjacent point judgments. Furthermore, as Garner observed:

> The optimum number of rating categories, or at least the number beyond which there will be no further improvement in discrimination, is clearly a function of the amount of discriminability inherent in the stimuli being rated. Thus, there can be no single number of rating categories appropriate to all rating situations. At the limits of discriminability, this fact is obvious (Garner, 1960:350).

A seven interval scale was used for the user satisfaction measurement instrument. The rationale for this decision had two main points. The study of the metric properties of the semantic differential by Messick (1957) established the interval property of the seven point scale (reported in Chapter 2). This was a very desirable property that allowed a more sophisticated statistical analysis of the resulting scores. This property was not established for other than seven point scales.

The second reason for the seven intervals was the communication sensitivity that was achieved. Osgood, Suci, and Tannenbaum (1957:11) declared that the measurement method "should yield differentiations commensurate with the natural units of the material being studied, i.e., should be

able to reflect as fine distinctions in meaning as are typically made in communicating". It was felt that the seven response categories, labeled with the polar adverbs _extremely_, _quite_, and _slightly_ on both sides of the neutral response category, did form natural groups that reflected typical communication patterns describing user satisfaction. The use of seven categories over four evaluation scales allowed a quantitative distinction of 28 values after averaging, ranging in mean scores from -3 to +3 in steps of .25. Therefore, a score of +1.5 could be interpreted as halfway between "slightly satisfied" and "quite satisfied". It was not felt that a finer discriminatory scale would achieve a proportionally greater explanatory or communicative power.

If a factor was not applicable, the subject was instructed to check the midpoint of all the scales. This gave an effective score, weighted or unweighted, of zero for that factor's contribution to the overall satisfaction measure.

Choice of Adverb Modifiers

The metric characteristics of the adverb qualifiers _extremely_, _quite_, and _slightly_ were examined by Cliff (1959) and found to combine multiplicatively with adjectives to define rating positions of almost equidistant intensity. The neutral point of intensity was assumed to be located at

the midpoint of the scale. This assumption was supported for the summated range of the scales by McCroskey, Prichard, and Arnold (1967).

Therefore, the seven intervals of the scales were qualified by the adverbs, extremely, quite, slightly, equally or neither, slightly, quite, and extremely. This qualification was explained to the respondents in the instructions. The adverbs were not repeated throughout the instrument. Wells and Smith (1960) found that the ratings achieved with and without the response categories being constantly labeled were practically equivalent.

Order of the Scales

The scales were ordered consistently for each factor. The four evaluation scales identified by the selection procedure were randomly ordered in the first four positions. These were followed in order by the "satisfactory - unsatisfactory" and "important - unimportant" scales. There was no evidence reported that the order of the scales influenced the ratings. An unweighted factor score was computed as the average of the four evaluation scale scores. The practice of following these scales by the "satisfactory - unsatisfactory" scale, included as a measure of internal consistency, allowed a rapid visual check of the consistency of a subject's rating style. The order also simplified the data coding procedure for analysis.

The "important - unimportant" scale was last in order. It was also separated from the other scales by the statement, "For me, this factor is." Since this scale required a different type of judgment (importance rather than evaluation), the statement set the scale apart to provide a break in the subject's evaluative thought process. The statement also provided a subtle reminder to the subject to rate the factors according to his own feelings rather than an overall judgment reflecting the feelings of other users.

The polarity of the scales was consistent with the positive adjective located on the left. Some investigators randomly alternated the positive term between the left and right side (Heise, 1970). This practice was criticized by Nunnally:

> The purpose of such reversals of polarity is to prevent subjects from being influenced from scale to scale by ratings made on previous scales. To the extent that this is accomplished by alternating directions of scales, however, is not worth the price in measurement error. One frequently sees ratings where subjects apparently became confused by the numerous alternations of scale directions... and rates a concept as both "very good" and "very worthless". The weight of the argument is for keeping the scales pertaining to any factor all pointing in the same direction (Nunnally, 1967:542).

<u>Order of the Factors</u>

The user satisfaction factors were randomly ordered. Although Somer (1965) found no effect of context or order on the subject ratings, it was felt that the random order would provide some variety and a more interesting task to

the respondents.

Instruction Set

Several sample instruction sets for semantic differential instruments were illustrated in Osgood, Suci, and Tannenbaum (1957) and Nunnally (1961). One criticism levied against the sample instructions was that the length and elaborateness were excessive for the relatively simple task required of the subject (Axelrod, 1976). A simplified instruction set was devised and provided to the Survey Research Center of Arizona State University for preliminary evaluation. The final instruction set incorporated suggestions made by the Center.

Assembly

The set of 39 user satisfaction factors, with the respective scales, were assembled into a seven by eight and a half inch booklet with the instructions on the first page. Two factors were placed on each additional page. The factor phrases were numbered and enclosed in a box for differentiation from the scales. The statement "To me, this factor is" which preceded each "important - unimportant" scale was similarly enclosed in a box. The use of boxes for visual highlighting was recommended by Oppenheim (1966) and Babbie (1975). Both boxes were offset slightly to the left. Osipow and Grooms (1962) found that such offsets of the response stimulus did not result in a response bias. The

booklet was bound with a cover depicting a bold graphic to provide visual attractiveness. A copy of the booklet pages is included in Appendix 4.1.

PRELIMINARY EVALUATION

The completion of the user satisfaction measurement instrument was followed by a preliminary evaluation. Four user subjects were selected as a coarse representation of the user population of interest. These subjects completed the questionnaire and provided an assessment of the following:

1. Clarity of the instructions
2. Clarity of the intent of the scales
3. Clarity of the factor phraseology
4. Time to complete the instrument

The preliminary test determined that the instructions were clear and that there was no confusion in interpreting the scales, with one exception. Two of the test subjects indicated that the scale "reserved - unreserved" for the factor Confidence in systems, was ambiguous. An alternate adjective pair, "definite - uncertain", identified from the selection procedure, was acceptable to the subjects as a replacement. Several suggestions by the subjects on the factor phraseology were incorporated as improvements. The time for completion ranged from 15 minutes to 25 minutes. This was within the 30 minute upper bound that was targeted.

This preliminary evaluation concluded the construction of the measurement instrument.

SUMMARY

The semantic differential methodology was combined with the user satisfaction domain to construct the measurement instrument. The specific adjective pairs for the factor scales were selected in a two-step, Delphi type procedure. Five university professors participated in the selection process. The adjective pairs defined four evaluation scales for each factor. The evaluation scales were augmented by an internal consistency scale and an importance weighting scale.

The scales for each factor were composed into a questionnaire booklet. The format of the booklet was designed to enhance the effectiveness of the measurement process. A preliminary evaluation by four user subjects confirmed that the instrument was clear, unambiguous, and visually attractive.

The construction of the instrument established the functional means to measure user satisfaction. The instrument was constructed under careful guidelines for the content domain defined by the methodology of Chapter 3. The next chapter presents an evaluation of the reliability and validity of this instrument.

Chapter 5

EVALUATION OF THE MEASUREMENT INSTRUMENT

This chapter presents an evaluation of the measurement instrument. The administration of the measurement instrument to a subject group and the scoring of the results is described. The results are analyzed with the aid of the Statistical Package for Social Scientists (SPSS) computer programs for factor analysis and Pearson product-moment correlation. These SPSS programs are augmented by data reduction and analysis of variance programs developed specifically for this research.

The evaluation first centers on the reliability property of the instrument. Analysis of variance is used to show that the estimated errors of measurement are insignificant in relation to the variance in the scores attributed to the measurement technique. The reliabiliy coefficients range from .7527 to .9828.

The evaluation next focuses on the validity properties of the instrument. Three categories of measurement validity are identified as (1) content validity, (2) predictive validity, and (3) construct validity. The scores resulting from the measurement instrument are analyzed for characteristics associated with each of these categories to establish the overall validity properties.

The accumulated results confirm that the measurement instrument is both reliable and valid for its intended purpose. Therefore, the research objective of user satisfaction measurement is effectively demonstrated.

ADMINISTRATION AND SCORING

The 32 middle managers who were interviewed in the initial phase of the research were selected as the subject group for evaluation of the measurement instrument. The selection of this sample is described in Chapter 3. The representativeness of the subjects and their continued commitment to participate in this research were influencing factors in this selection; however, the primary reason for using this particular group of subjects was the existence of self-assessments of their satisfaction states at the time of the interviews. At the conclusion of each interview, each subject was asked to consider his total current computer support environment and to indicate his position on the seven interval satisfaction scale shown in Figure 5.1.

	Extremely	Quite	Slightly	Equally	Slightly	Quite	Extremely	
Satisfied								Dissatisfied

Figure 5.1

Satisfaction Scale

These self-assessments partitioned the subjects into groups of users who considered themselves to be satisfied or dissatisfied by varying degrees with their current computer support. This partitioning of users according to their satisfaction states was a significant asset for determining the validity of the measurement instrument.

Administration of the user satisfaction measurement instrument was initiated four to six weeks after completion of the interviews. Twenty-nine of the 32 subjects completed and returned the measurement booklets. An informal follow-up to seven of the subjects indicated that the time to complete the booklet had ranged from 15 to 25 minutes.

The measurement booklets were scored according to the following procedures. Each of the 39 factors of the user satisfaction construct domain was rated on six scales. Four of the scales were for evaluation measurement. The fifth scale, defined by the adjective pair "satisfactory - unsatisfactory", was used for internal consistency purposes as a direct assessment of the subject's feeling about the factor. The sixth scale, defined by "important - unimportant", was used to weight the factor in the overall score. Each scale had seven interval response categories. The integers +3, +2, +1, 0, -1, -2, and -3 were assigned to the intervals for the first five scales with +3 being assigned to the most favorable response interval.

The sixth scale was defined by a linear weighting function to modify the factor scores to reflect the saliency of each factor in the overall score. The weights assigned to each interval were 1.00, .85, .70, .55, .40, .25, and 10. The weight 1.00 was assigned to the response "extremely important". The weights were selected arbitrarily to provide an equal differential of .15 (approximately 1/7) between adjacent intervals.

The scale response of subject k for adjective pair j of factor i is denoted by I_{kij}. The raw score of factor i for subject k was calculated as the mean response for the four evaluation scales and denoted FS_{ki}. Therefore, the potential range of the factor scores was +3 to -3 in .25 increments. The weighted factor score (WFS_{ki}) was the product of the factor score multiplied by the weight determined by the sixth scale response. The factor satisfaction score (FSS_{ki}) was determined by the fifth scale response. The total satisfaction score denoted TS_k was the sum of all of the unweighted factor scores. The weighted total satisfaction score, denoted WTS_k, was the sum of all of the weighted factor scores. The potential range of both the TS_k and the WTS_k was +117 to -117 (39 times +3 and -3, respectively). Figure 5.2 summarizes the scoring procedures.

A computer program was developed using the FORTRAN IV language to summarize the raw data extracted from the

Factor Score (FS)* for factor i of subject k:

$$FS_{ki} = \left(\sum_{j=1}^{4} I_{kij}\right)/4 \qquad i = 1,2,\ldots,39$$

Total Satisfaction Score (TS) for subject k:

$$TS_k = \sum_{i=1}^{39} FS_{ki}$$

Total Weighted Satisfaction Score (WTS) for subject k:

$$WTS_k = \sum_{i=1}^{39} FS_{ki}\, W_{ki}$$

where

I_{kij} = Subject k's response to scale j of factor i

W_{ki} = Importance weight for factor i as given by subject k

W_{ki} = 1.00 if $I_{ki,5}$ = +3

W_{ki} = .85 if $I_{ki,5}$ = +2

W_{ki} = .70 if $I_{ki,5}$ = +1

W_{ki} = .55 if $I_{ki,5}$ = 0

W_{ki} = .40 if $I_{ki,5}$ = -1

W_{ki} = .25 if $I_{ki,5}$ = -2

W_{ki} = .10 if $I_{ki,5}$ = -3

Figure 5.2

Scoring Procedures

subject booklets and to create input files for subsequent analysis. A copy of the program is shown in Appendix 5.1. The program output included the weighted and unweighted factor scores and total scores. The TS_k and WTS_k for each subject are shown in Table 5.1.

A comparison of the weighted and unweighted satisfaction scores in Table 5.1 revealed a very close correspondence. The Pearson product-moment (PPM) correlation coefficient for the scores was .9968. This extremely high correlation coefficient indicated that the linear relationship between the scores was almost perfect. Therefore, the use of a weighting function to alter the factor scores did little to increase the information conveyed by the less complex unweighted satisfaction score.

The individual booklets were examined to attempt to explain this unexpected finding. The examination indicated that the subjects tended to "weight" the factors by their responses on the evaluation scales. There was a tendency for "important" factors to achieve more extreme evaluation ratings while the "unimportant" factors were more neutrally (middle of the scale) rated. This minimized the effect of the weighting function of the overall score. This propensity supported a number of researchers who contended that differential weighting was unnecessary (Mobley and Locke, 1970; Beckwith and Lehmann, 1973).

Table 5.1

Satisfaction Scores

Subject	Unweighted	Weighted
A1	111.75	106.99
A2	49.75	48.21
A3	69.25	67.15
A4	41.50	36.21
B1	15.25	17.24
C1	48.50	44.00
C3	20.00	19.51
C4	-4.75	-3.81
C5	-7.00	-2.65
D1	54.25	45.93
D2	31.25	29.71
D3	60.25	52.41
E1	63.75	53.40
E2	57.75	51.75
E3	31.75	26.91
E4	83.00	75.99
F1	-38.00	-36.84
F2	-46.75	-44.31
F3	-27.75	-27.75
F4	-15.50	-10.03
F5	-64.25	-61.59
G1	21.50	17.64
G2	18.50	12.99
G3	17.75	11.79
G4	-15.75	-14.36
H1	60.50	49.29
H2	33.75	28.39
H3	55.25	51.31
H4	56.25	46.28

Therefore, the usefulness of the "important - unimportant" scale in the measurement instrument was confined to the identification of the factors considered significant by the individual subjects. The subsequent evaluation was based only on the unweighted factor and total scores. The following sections analyze the responses of the 29 subjects to establish the reliability and validity properties of the measurement instrument.

RELIABILITY

Reliability is defined as the relative absence of measurement errors. Thus, reliability is concerned with the accuracy of a measurement instrument or, restated, the extent to which the obtained scores reflect the "true" scores of the property being measured. Since the "true" scores are unknown in any set of obtained scores, the error scores are also unknown and must be estimated. This estimate is based upon the assumption that the errors are independent and random. They are assumed to be uncorrelated to the true scores. Therefore, the total variance in any set of measurement scores is composed of "true" variance and error variance.

The reliabiliiy of the user satisfaction measurement instrument was determined by the proportion of variance in the factor scores that was attributable to measurement error. For any set of scores obtained by the instrument,

the total variance was composed of the variance from individual subject differences and the error variance. An analysis of variance (ANOVA) approach was used to calculate the total variance and the different variance components for each factor score. A sample ANOVA table is illustrated in Figure 5.3. Readers unfamiliar with analysis of variance are referred to Walpole and Myers (1972) or Hicks (1973), among others. The reliability coefficient for each factor was computed by the equation:

$$r_{tt} = 1 - (V_e \;/\; V_{sub}) \tag{5.1}$$

where

r_{tt} = the reliability coefficient

V_{sub} = variance due to subject difference

V_e = error or residual variance

This method of estimating reliability has been widely accepted (Thorndike, 1967; Nunnally, 1967; Kerlinger, 1973; Summey, 1974). Kerlinger explained the interpretation of the coefficient:

> The reliability coefficient is a coefficient of determination. Theoretically, it tells how much variance of the total variance of a measured variable is "true" variance. If we had the "true" scores and could correlate them with the scores of the measured variable and square the resulting coefficient of correlation, we would obtain the reliability coefficient (Kerlinger, 1973:451).

A separate reliability coefficient was calculated for each of the 39 factors which comprise the user satisfaction domain. This was required because each factor represented a

Factor 39

SUBJECTS	SCALE 1	2	3	4	TOTALS
1	7.00	7.00	7.00	7.00	28.00
2	7.00	7.00	7.00	7.00	28.00
3	4.00	4.00	4.00	4.00	16.00
4	5.00	6.00	5.00	5.00	21.00
5	1.00	1.00	2.00	2.00	6.00
6	4.00	4.00	4.00	4.00	16.00
7	2.00	2.00	3.00	3.00	10.00
8	2.00	4.00	4.00	4.00	14.00
9	2.00	2.00	2.00	2.00	8.00
10	5.00	5.00	5.00	4.00	19.00
11	3.00	3.00	2.00	3.00	11.00
12	6.00	6.00	5.00	6.00	23.00
13	5.00	3.00	5.00	4.00	17.00
14	2.00	2.00	3.00	3.00	10.00
15	3.00	5.00	5.00	5.00	18.00
16	6.00	6.00	7.00	6.00	25.00
17	2.00	2.00	2.00	2.00	8.00
18	1.00	1.00	1.00	1.00	4.00
19	1.00	1.00	1.00	1.00	4.00
20	1.00	1.00	1.00	1.00	4.00
21	1.00	1.00	1.00	1.00	4.00
22	5.00	5.00	5.00	5.00	20.00
23	3.00	3.00	3.00	3.00	12.00
24	2.00	2.00	3.00	3.00	10.00
25	2.00	2.00	2.00	2.00	8.00
26	6.00	5.00	5.00	5.00	21.00
27	2.00	2.00	3.00	4.00	11.00
28	4.00	5.00	4.00	4.00	17.00
29	6.00	6.00	7.00	6.00	25.00
TOTAL	100.00	103.00	108.00	107.00	

Source	SS	DF	MS
TOTAL	409.76	115.00	
SCALES	1.41	3.00	.47
SUBJECTS	388.26	28.00	13.87
ERROR	20.09	84.00	.24

Figure 5.3

Sample ANOVA Table*

*The scale values include a constant of +4.0 which was added to eliminate negative numbers during the input process.

unique, independent measurement problem. A computer program was developed using FORTRAN IV to perform the required analysis of variance and computation of the reliability coefficients for each factor. Additional factor statistics were also computed. The program listing and a sample output is shown in Appendix 5.2. The reliability coefficients are shown in Table 5.2.

The reliabilty coefficients obtained were exceptionally high. Thirty-two of the 39 factors had a coefficient that exceeded .90. The minimum coefficient was .7527. These results indicated that very little of the variation in the factor scores was attributable to measurement error. Rather, the differences were a result of measured differences between the subjects. This level of reliability was very favorably comparable to reliability coefficients developed in similar research (Heise, 1969; Summey, 1974). Reliability was a necessary but not sufficient condition for validity (Nunnally, 1967). The next section discusses the evaluation of the measurement instrument for validity.

VALIDITY

The validity of a measurement instrument is determined by the extent to which it measures what it is supposed to measure. While the theory of measurement error is well developed and straightforward for establishing reliability, there is no well defined process for documenting the

Table 5.2

Reliability Coefficients by Factor (F_i)

Factor i	Reliability Coefficient	Factor i	Reliability Coefficient
1	.9295	21	.9188
2	.8469	22	.9446
3	.9347	23	.9431
4	.7527	24	.9575
5	.9826	25	.8614
6	.9237	26	.8327
7	.9365	27	.9133
8	.9662	28	.9630
9	.9008	29	.9624
10	.8902	30	.9651
11	.9143	31	.8125
12	.8698	32	.9297
13	.9324	33	.9542
14	.9787	34	.9495
15	.9256	35	.9688
16	.9286	36	.9683
17	.9500	37	.9602
18	.9417	38	.9724
19	.9733	39	.9828
20	.9060		

validity of a measurement instrument designed for psychometric purposes. Rather, validity is viewed as a property determined by logical as well as statistical arguments.

Three traditional categories of measurement validity have evolved, however, that characterize the different aspects of validity as well as the approaches that have been pursued to demonstrate this property. These are (1) content validity, (2) predictive validity, and (3) construct validity (Ghiselli, 1964; Nunnally, 1967). The reader is referred to Chapter 2 for a fuller discussion of these categories. The user satisfaction measurement instrument was evaluated for each of the three types of validity.

Content Validity

Content validity is determined from the content and operations of the measurement instrument. It is sometimes referred to as "face validity" (Babbie, 1975). Content validity implies that the content of the construct or attribute being measured has been adequately sampled from the total construct domain and that the operations to measure this content are logically sound (Ghiselli, 1964).

The content of the user satisfaction measurement instrument was designed to include all important factors affecting a user's satisfaction with the computer support provided to him within the organization. The methodology to identify those factors and to test for the completeness of

the factor list is presented in Chapter 3. The probability of any factor considered important by a user being included in the measurement instrument exceeded .90 in a test of hypotheses at the .01 level of significance. This was compelling evidence that the domain of the user satisfaction construct had been more than "adequately" sampled in the construction of the measurement instrument.

The semantic differential methodology was used to establish the operations for measuring this content. An extensive evaluation of the appropriateness of this methodology selection is presented in Chapter 2. The careful development of the measurement instrument itself is described in Chapter 4. It was felt that this deliberate and prudent approach to the functionalization of the measurement process justified a validity claim; however, this was ultimately a subjective judgment. Therefore, the response structures of the 29 subjects who were administered the instrument were examined for further evidence of content validity that was not based upon subjective judgments.

Three characteristics of the response structures were considered indicative of content validity. The first was homogeneity or internal consistency of the individual factor scales. Scales which purport to measure the same thing should be positively correlated (or homogeneous). The second was unidimensionality of the scales within each factor. Since the satisfaction construct was considered to

be composed of only the Evaluation dimension of connotative feeling, the factor scales should reflect only one dimension. Finally, the third characteristic was scale discrimination between "satisfied" and "dissatisfied" subjects.

The Pearson product-moment (PPM) correlation coefficients were calculated for each pair of scales for each factor to determine the homogeneity of the measurement instrument. The correlation coefficients are shown in Table 5.3. A significance test for the correlation coefficient r was derived from the use of the Student's t distribution with N-2 degrees of freedom for the quantity

$$r\ [\ (N-2)/(1-r^2)\ ]^{\frac{1}{2}}$$

(Nie, Hull, Jenkins, Steinbrenner, and Bent, 1970). All but 8 of the 156 coefficients were significant at the .01 level. All but one of the coefficients were significant at the .05 level. It was concluded that the measurement instrument was internally consistent.

Factor analysis was used to examine the scales for unidimensionality. Factor analysis is a mathematical method of discovering patterns in the variations of the values of several variables. This is accomplished by the generation of artificial dimensions, termed "factors" (these should not be confused with the factors in the measurement instrument), which correlate highly with several of the variables and that are independent of one another (Babbie, 1975). The

Table 5.3

Correlation Coefficients Between Factor Scales

Factor i	Scale Pairs i,j 1,2	1,3	1,4	2,3	2,4	3,4
1	.9279	.6746	.7761	.7466	.7487	.7646
2	.8952	.3489	.5149	.4537	.6744	.5678
3	.7349	.8404	.7254	.8468	.7406	.8031
4	.6750	.3856	.6733	.0156	.3821	.6079
5	.9555	.9486	.9264	.9355	.9486	.8985
6	.7783	.7098	.8521	.6456	.6769	.8554
7	.9332	.9322	.6680	.9173	.7126	.7721
8	.9624	.8967	.8287	.8934	.8227	.8797
9	.8705	.4842	.6577	.6271	.7734	.7886
10	.4179	.9222	.8136	.4993	.4802	.8951
11	.7894	.6652	.7598	.9061	.6197	.6237
12	.8963	.7263	.4492	.7839	.4257	.4773
13	.8600	.7619	.6914	.7634	.6849	.8994
14	.9558	.9449	.8683	.9616	.8812	.9200
15	.8645	.8262	.6652	.8539	.6147	.7059
16	.6421	.8500	.8320	.6796	.7701	.8140
17	.7965	.8088	.8635	.8241	.8217	.8577
18	.9009	.7234	.8597	.8353	.8114	.8295
19	.9135	.9135	.8655	.9235	.8765	.9304
20	.6823	.9090	.7746	.6959	.4992	.6796
21	.7099	.6979	.6906	.8444	.7639	.7802
22	.9527	.6782	.9305	.7002	.9052	.7193
23	.8898	.8994	.7521	.8537	.7345	.7698
24	.9541	.8576	.8107	.8435	.8449	.7965
25	.8451	.8734	.4778	.7432	.4517	.4543
26	.5979	.5286	.5727	.4214	.4764	.8175
27	.5964	.9083	.8551	.5392	.6143	.8649
28	.9560	.8594	.8062	.9142	.8554	.8436
29	.8827	.8950	.9101	.8309	.8262	.8856
30	.8564	.8276	.8180	.9040	.9151	.9441
31	.4281	.3481	.6408	.6854	.5467	.5375
32	.7332	.7173	.6630	.8269	.7593	.9032
33	.8599	.7780	.9233	.8391	.8650	.7806
34	.8061	.8628	.7516	.8958	.7837	.8849
35	.8902	.8964	.9592	.8692	.8616	.8810
36	.7982	.8859	.8809	.8723	.8792	.9839
37	.8632	.8632	.9121	.8034	.8175	.8863
38	.9374	.8406	.9355	.8740	.9142	.8952
39	.9327	.9257	.9175	.9336	.9474	.9658

number of factors that are generated is a function of the number of "clusters" that exist in the variables. One output of factor analysis is the "factor loadings" which are the correlations between each factor and each variable. Factor analysis is actually a generic term that subsumes a variety of techniques. The statistical basis is sufficiently complex that the interested reader is referred to Harmon (1967) or Nie, Hull, Jenkins, Steinbrenner, and Bent (1970) for a more complete discussion.

The scale values for each user satisfaction factor were input as variables to the SPSS factor analysis program. A sample output is shown in Appendix 5.3. With one exception, the scale values were defined by only one dimension. The exception was the factor Organizational Competition with the EDP Unit (F_4) which had two dimensions. The second dimension for this factor was due to the third scale which did not correlate strongly with the other evaluative scales. This exception was not considered to be significant because the factor was ranked next to last in importance by the subjects. The single factor loadings are shown in Table 5.4. These results confirmed the unidimensionality of the scales in the measurement instrument.

The scales discrimination between "satisfied" and "dissatisfied" users was next examined on a factor by factor basis. The 29 subjects were dichotomized into a satisfied or dissatisfied group based upon the sign (plus or minus,

Table 5.4

Scale Factor Loadings

Factor i	Scale 1	2	3	4
1	.9190	.9424	.8026	.8550
2	.8076	.9983	.5276	.7207
3	.8590	.8705	.9687	.8405
4	.8827	.6402	.5637	.8173
4*	.1897	.5775	.5960	.2463
5	.9791	.9838	.9552	.9507
6	.9104	.7791	.8413	.9433
7	.9452	.9568	.9868	.7458
8	.9639	.9591	.9509	.8806
9	.7967	.9391	.7258	.8918
10	.9055	.4974	.9993	.9054
11	.8600	.9398	.8664	.7484
12	.9127	.9489	.8297	.4996
13	.8694	.8670	.9347	.8551
14	.9618	.9772	.9910	.9114
15	.9183	.9114	.9327	.7192
16	.8938	.7657	.9014	.9403
17	.9012	.8863	.9125	.9417
18	.9140	.9456	.8604	.9177
19	.9407	.9514	.9799	.9309
20	.9908	.7048	.9326	.7466
21	.7835	.9084	.9118	.8573
22	.9700	.9641	.7253	.9581
23	.9551	.9184	.9423	.8014
24	.9617	.9719	.8904	.8677
25	.9803	.8581	.8823	.5077
26	.7169	.6094	.8161	.8815
27	.9506	.6232	.9307	.9267
28	.9374	.9933	.9319	.8748
29	.9723	.8944	.9312	.9373
30	.8691	.9577	.9599	.9614
31	.6217	.7728	.7236	.8022
32	.7717	.8792	.9636	.8925
33	.9389	.9366	.8606	.9431
34	.8720	.9063	.9966	.8730
35	.9810	.9142	.9270	.9580
36	.8945	.8868	.9894	.9903
37	.9610	.8794	.9150	.9495
38	.9571	.9620	.9030	.9720
39	.9499	.9688	.9752	.9783

* Loading on second dimension

respectively) of their total factor score (average of the four scales). The scale means for each group were then calculated. The range for each scale was the difference between the two group means. The range was indicative of the discriminatory power of the scale. The scale ranges are shown in Table 5.5. Ninety-seven of the 156 scales had a range of more than 3 intervals. The minimum range for any scale was 1.67 intervals. Therefore, each of the scales was considered to be sufficiently discriminating.

Therefore, the response structures of the subjects exhibited the desired characteristics of homogeneity, unidimensionality, and discrimination. When considered with the methodologies used to define the content of the measurement instrument and to measure that content, the claim of content validity was deemed to be justified.

Predictive Validity

Predictive validity is traditionally signified by the correlation between the measurement scores and some independent criterion that is assumed to represent the "true" state of the attribute being measured. The usefulness of predictive validity measures has often been limited by the absence of an appropriate independent criterion. This limitation has been especially acute for psychometric measurement instruments designed to measure "how much" of an attribute exists in a subject (Nunnally, 1967).

Table 5.5

Scale Range Between Means

Factor i	Scale 1	2	3	4
1	3.46	3.33	2.67	2.29
2	2.61	2.96	2.08	2.65
3	2.95	3.43	3.24	3.38
4	1.98	1.67	2.09	2.00
5	4.04	3.63	3.43	3.53
6	4.50	4.54	3.87	3.87
7	2.12	2.52	2.28	3.49
8	4.38	3.99	4.04	3.38
9	3.00	3.11	2.50	3.22
10	2.88	2.05	2.83	2.48
11	3.75	4.17	3.37	2.45
12	3.24	2.75	2.26	1.81
13	3.59	3.30	3.66	2.90
14	3.03	3.02	3.23	2.80
15	2.50	3.25	2.73	1.87
16	3.39	2.28	3.23	3.48
17	3.03	3.58	3.70	3.08
18	3.97	2.89	1.89	3.18
19	3.75	3.96	3.42	3.37
20	2.93	2.12	2.31	1.81
21	2.00	3.01	2.29	3.87
22	3.34	3.29	2.70	3.24
23	3.13	3.13	2.50	3.25
24	3.76	3.55	3.33	3.05
25	3.89	4.11	3.86	3.57
26	2.37	1.97	2.51	2.31
27	4.27	2.55	3.86	3.19
28	3.71	3.30	3.12	2.74
29	3.46	3.67	2.46	2.67
30	2.82	3.05	3.45	3.12
31	2.70	2.08	2.15	2.10
32	2.55	2.78	3.10	3.45
33	3.39	3.19	2.72	3.06
34	4.00	3.00	3.04	2.85
35	3.23	4.15	3.15	3.08
36	3.24	3.24	3.58	3.62
37	3.24	2.70	2.97	2.94
38	3.70	3.75	3.35	3.38
39	3.62	3.57	3.38	3.00

There was no known independent criterion external to this research that specifically addressed the satisfaction of a user, either by factor or total score, that could be used to evaluate the user satisfaction measurement instrument. Two data elements, however, were collected during this research that were conducive to the predictive validity evaluation. The first was the self-assessment by each subject of his total satisfaction state at the time of the initial interview. These assessments were made four to six weeks prior to the administration of the measurement instruments. Therefore, the subject group was partitioned into "known" groups along a total satisfaction scale.

The self-assessments and the measured satisfaction scores of the subjects are shown in Table 5.6. The subjects are grouped by organization. A graph of the scores is illustrated in Figure 5.4 with the horizontal axis representing the self-assessment and the vertical axis representing the measured score. The data points are identified by subject. The PPM correlation coefficient for the two scores was .7899. This was significant at the .001 level. It was felt that this correlation was quite high considering that the self-assessment scores could assume only one of seven values. This correlation between the measured scores and an independent criterion of user satisfaction was indicative of predictive validity.

Table 5.6

Subject Satisfaction Scores

Subject	Self-Assessed Score	Measured Score	Organizational Mean
A1	+3	111.75	68.06
A2	+2	49.75	
A3	+3	69.25	
A4	+2	41.50	
B1	+2	15.25	15.25
C1	+2	48.50	14.19
C3	-1	20.00	
C4	-2	-4.75	
C5	-1	-7.00	
D1	+1	54.25	48.58
D2	+1	31.25	
D3	+2	60.25	
E1	+2	63.75	59.06
E2	+2	57.75	
E3	+2	31.75	
E4	+3	83.00	
F1	-2	-38.00	-38.45
F2	-2	-46.75	
F3	-2	-27.75	
F4	+1	-15.50	
F5	-3	-64.25	
G1	+2	21.50	10.50
G2	+1	18.50	
G3	+1	17.75	
G4	+2	-15.75	
H1	+2	60.75	51.50
H2	-2	33.75	
H3	+2	55.25	
H4	+2	56.25	

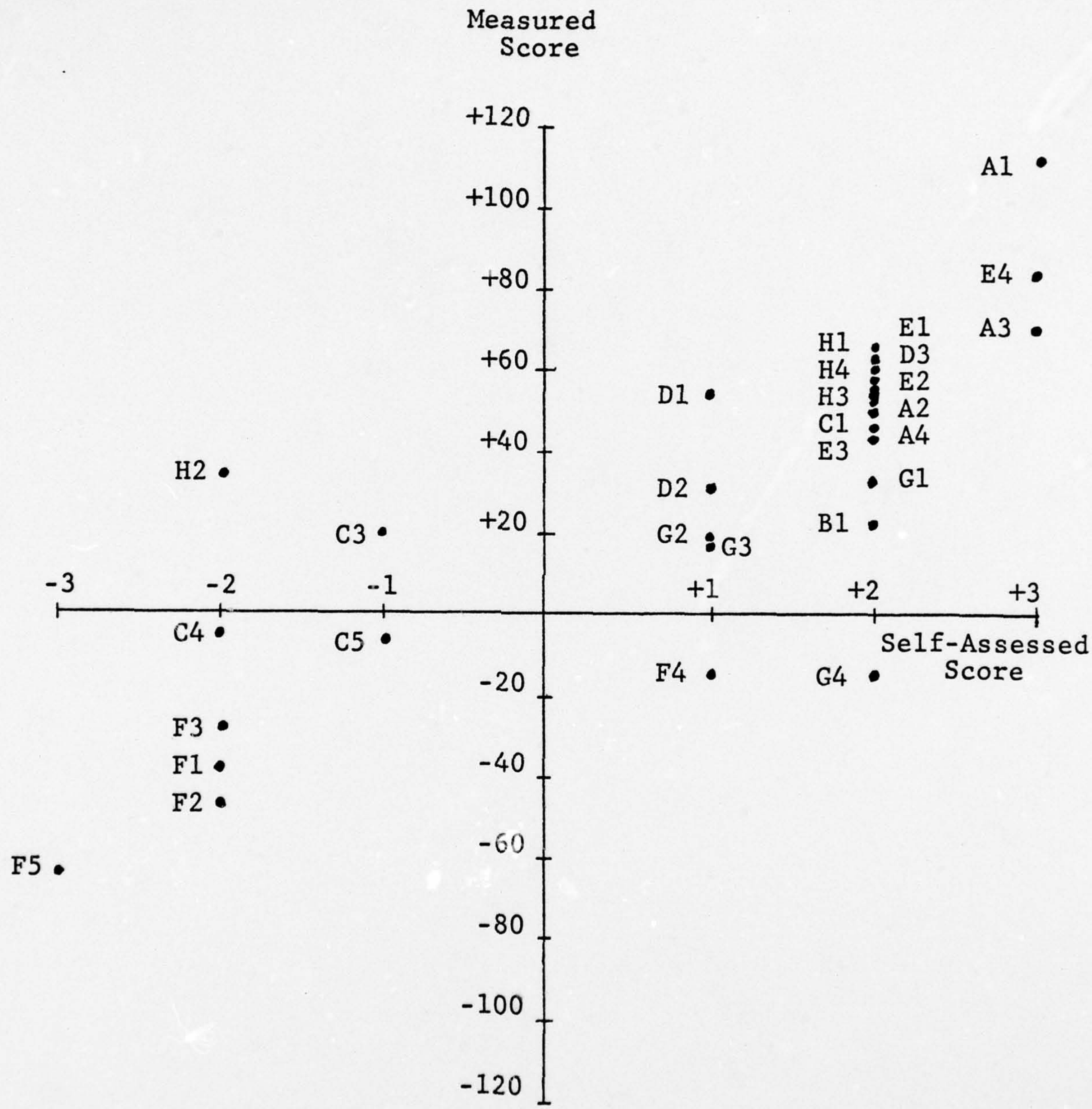

Figure 5.4

Subject Self-Assessed and Measured Satisfaction Scores

This evidence was further supported by the linearity exhibited by the subject scores. After partitioning the groups according to their self-assessments, the mean measured scores were calculated for each group. The response group means are shown in Table 5.7.

The second data element for evaluating predictive validity was provided in the measurement instrument itself. A separate scale defined by the adjective pair "satisfactory - unsatisfactory" was included for each factor. This scale was considered a "direct" assessment of the subject's satisfaction with the individual factors. This direct assessment should correlate highly with the factor score determined by the four evaluation scales. The independence of this criterion was subject to question because it was collected at the same time and in the same manner as the measured scores; therefore, the absence of a high correlation would have been more significiant as a negative indication of predictive validity than the converse condition. However, as the results shown in Table 5.8 indicate, the correlations were extremely high for the two variables. The PPM correlation coefficients ranged from .7454 to .9719 and were significant at the .001 level.

The results accumulated in this evaluation of the subject self-assessments and the direct factor scores sustained the predictive validity property of the user satisfaction measurement instrument. Since the subject

Table 5.7

Response Group Mean Scores

Self-Assessment Response Group	Measured Mean Score (subjects)
Extremely Satisfied	88.00 (3)
Quite Satisfied	42.04 (13)
Slightly Satisfied	21.25 (5)
Slightly Dissatisfied	6.50 (2)
Quite Dissatisfied	-16.70 (5)
Extremely Dissatisfied	-64.25 (1)

Table 5.8

Satisfaction Scale and Factor Score Correlation

Factor i	Correlation Coefficient
1	.9273
2	.8769
3	.9468
4	.7454
5	.9699
6	.9207
7	.8237
8	.9719
9	.9659
10	.8666
11	.8967
12	.9169
13	.9130
14	.9656
15	.9469
16	.9252
17	.9490
18	.9368
19	.9158
20	.8451
21	.8044
22	.9283
23	.9700
24	.9443
25	.9099
26	.8880
27	.8832
28	.9003
29	.8434
30	.9267
31	.8860
32	.9279
33	.8752
34	.8052
35	.9585
36	.9673
37	.9530
38	.9359
39	.9218

group had participated throughout the research, an attempt was made to develop yet another independent criterion for comparing the measured scores. The vice president of a local computer company, which sells and services hardware and software systems for small businesses, was contacted and asked to identify six customers in each of three categories according to the instructions shown in Appendix 5.4. The categories were customers who were (1) extremely satisfied, (2) extremely dissatisfied, and (3) slightly satisfied or dissatisfied. He was asked to identify only those customers whom he felt confident of placing in the correct category. This request proved to be much more difficult than presumed. Although six customers were named for each group, some were named by the vice president with trepidation that they were mislabeled.

Each of the users identified in this manner was asked to complete the measurement booklet. Eleven of the users completed and returned the booklet. The subject scores by response category, shown in Table 5.9, were less than conclusive. Although the two highest and the two lowest user scores were associated with the expected response categories, the other scores did not fall neatly within predicted clusters. The mean scores of the response categories did, however, rank in the expected order. Only two of the subjects, S3 and D4, achieved scores significantly different than their category would indicate. This

Table 5.9

Measured Scores

Response Category	Subject	Score	Category Mean
Extremely Satisfied	S2	82.00	
	S3	37.50	
	S4	62.75	72.75
	S5	66.00	
	S6	115.50	
Slightly Satisfied or Dissatisfied	M1	65.50	
	M5	74.25	67.67
	M6	63.25	
Extremely Dissatisfied	D1	-4.25	
	D4	59.00	-9.50
	D6	-64.25	

anomaly was probably the result of misidentification during the selection process.

The user satisfaction measurement instrument was subjected to three approaches to determine predictive validity. It was felt that this property of the measurement instrument was confirmed by the combined results.

Construct Validity

Construct validity is based upon the behavior of the measurement scores conforming to expected relationships with the construct network of variables. Cronbach and Meehl (1955:300) state that "construct validity is possible only when some of the statements in the network lead to predicted relations among observables." This type of restriction is complicated by the fact that a "satisfaction" is not ever seen and is therefore not an observable. Surrogate criteria, such as the number of complaints or late bill payments, are themselves subject to questions of validity. Consequently, it is ordinarily necessary to evaluate construct validity by integrating evidence from the many different sources.

The only observables that were available to evaluate the user satisfaction measurement instrument for construct validity were the subject scores. The foundation for construct validity was embodied in the evaluation findings for content and predictive validity. The definition of the

user satisfaction construct and the subsequent definition of the content and the measurement process (content validity) established certain expectations regarding the response structures. The subject responses did exhibit the expected properties of internal consistency, unidimensionality, and scale discrimination. Furthermore, the subject responses correlated highly with the responses anticipated on the basis of external criteria (predictive validity). These relationships followed a pattern that implied construct validity.

Additional indications of construct validity were contained in the subject responses. In developing the content of the user satisfaction measurement instrument, importance had been attributed to the factors on the basis of literature references and subject mentions during interviews. The subject responses to the measurement instrument confirmed this implied importance. The mean response for each factor's "important - unimportant" scale is shown in Table 5.10 in descending order within the scale response boundaries. Each of the factors was accorded a positive importance mean. The relatively low means of the Language (F_{10}), Organizational competition (F_4), and Charge-back (F_7) factors were presumed to be a result of the lack of generality of the factors. For example, only one of the subject organizations utilized a charge-back method of payment for services. Nevertheless, every factor was ranked

Table 5.10

Importance Scale Means by Factor

Scale Mean	i	Factor (F_i)
+3.00 EXTREMELY IMPORTANT*		
2.59	28	Accuracy
2.48	19	Reliability
2.38	6	Timeliness
2.38	25	Relevancy
2.28	5	Confidence in systems
2.17	30	Communication with EDP staff
2.14	12	Error recovery
2.14	18	Attitude of the EDP staff
2.07	1	Relationship with the EDP staff
2.07	34	Schedule of products and services
2.07	37	Technical competence of the EDP staff
2.03	22	Response/turnaround time
2.03	27	Job effects
2.03	36	Completeness
+2.00 QUITE IMPORTANT*		
2.00	32	Time required for new development
1.97	2	Processing of change requests
1.97	17	Currency
1.97	38	Flexibility
1.93	8	Perceived utility
1.90	11	Expectations
1.86	21	Format of output
1.79	29	Precision
1.79	35	Documentation
1.72	3	Mode of interface
1.69	16	Feeling of participation
1.66	24	Convenience of access
1.62	13	Security of data
1.59	23	Priorities determination
1.55	39	Integration of systems
1.38	15	Understanding of systems
1.38	20	Top management involvement
1.38	33	Feeling of control
1.34	26	Volume of output
1.24	9	Vendor suppport
1.21	14	Degree of training
1.03	31	Organizational position of EDP function

Table 5.10 (continued)

Scale	i	Factor (F_i)
+1.00 SLIGHTLY IMPORTANT*		
.93	10	Language
.31	4	Organizational competition with EDP unit
.14	7	Charge-back method of payment of services

* Response boundary

"extremely important" by at least one subject.

The order of the factors rated most important overall also had logical appeal. The top rated four factors seemed to indicate the importance of computer information products and services that were accurate (F_{28}), reliable (F_{19}), timely (F_6), and relevant (F_{25}) to the user's needs. It appeared intuitive that these four factors formed the crux of the satisfaction construct.

The factors causing dissatisfaction were also revealing. The number of subjects expressing a negative, hence dissatisfied, score for each factor is shown in Table 5.11. The factors identified by an asterisk had more dissatisfied than satisfied users. The source of this dissatisfaction for these six factors was expressed in the literature reviewed in Chapter 3. The factor, Time required for new development (F_{32}), was cited often as being excessive from the user's standpoint (Neuschel, 1971; Stone and Tarnowieski, 1972; Colton, 1973). Similarly, Fitts (1971) found unresponsiveness to the Processing of change requests (F_2) a major irritant to users. These two factors, in conjunction with Flexibility (F_{38}) and Integration (F_{39}), seem to indicate a frustration on the part of the user to increasingly bring the power of the computer to bear on his problems.

In his survey of 616 computer users, Lucas (1973a) found that the desire for more training was the second most

Table 5.11

Number of Dissatisfied Subjects

Factor i	Number of Subjects	Factor i	Number of Subjects
1	3	21	4
2	13*	22	8
3	7	23	8
4	9	24	6
5	10	25	1
6	2	26	4
7	5	27	4
8	7	28	6
9	6	29	3
10	7	30	7
11	8	31	6
12	9	32	20*
13	4	33	9
14	18*	34	1
15	12	35	13
16	10	36	7
17	4	37	6
18	6	38	15*
19	4	39	15*
20	14*		

*More dissatisfied than satisfied subjects

"extremely important" by at least one subject.

The order of the factors rated most important overall also had logical appeal. The top rated four factors seemed to indicate the importance of computer information products and services that were accurate (F_{28}), reliable (F_{19}), timely (F_6), and relevant (F_{25}) to the user's needs. It appeared intuitive that these four factors formed the crux of the satisfaction construct.

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In his survey of 616 computer users, Lucas (1973a) found that the desire for more training was the second most

frequent comment in the open-ended section of the questionnaire. If the desire for more training may be translated as dissatisfaction, a similar finding was reflected in the large number of subjects dissatisfied with the Degree of training (F_{14}) factor. Likewise, Top Management involvement (F_{20}) was consistently characterized as vital to successful utilization of computer-based information systems within an organization (McKinsey and Company, 1969; Hofer, 1970; Fitts, 1971; Colton, 1973). It may be inferred that lack of such involvement could lead to dissatisfaction; however, there was no evidence to collaborate this with the subject responses of dissatisfaction for this factor.

Although the specific factors cited by the importance rankings or by the number of dissatisfied subjects have no quantitative relationship to the expected network of variables within the satisfaction construct, their appearance and order in relation to the other factors did not appear illogical. This was an important consideration for construct validity because illogical combinations of factors could have evolved. If, for example, the factor Accuracy (F_{28}) had achieved an extremely low importance ranking, either the construct definition or the measurement process would have been subject to question. Instead, the evidence of construct validity for the user satisfaction measurement instrument was reinforced by the rankings.

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MEASUREMENT OF COMPUTER USER SATISFACTION.(U)

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In order to further examine the subject responses, the 39 factor scores for each of the 29 subjects were subjected to a factor analysis using the SPSS factor analysis program. The intent was to determine if there was a logical pattern among the 39 factor intercorrelations. It should be noted that the factor analysis program will always generate factor-dimensions based on the empirical input. As such, it is strictly a tool to aid in the analysis of the data. Substantive meaning of the variables which load highly on the factor-dimensions is strictly a function of interpretation, not of the loadings themselves. The primary use of the factor analysis, therefore, is to aid in highlighting the patterns which exist and to stimulate the evaluation of the ramifications of the patterns.

Eight factor-dimensions were extracted from the measurement scores to "explain" the intercorrelations. The factor loadings were examined to find those variables (user satisfaction factors) which were highly loaded (greater than .50) on a single factor-dimension. Variables that were loaded on more than one factor-dimension were ignored. The variable clusters and the factor loadings are shown in Table 5.12. The complete factor-dimension matrix is contained in Appendix 5.5.

The clustering shown in Table 5.12 was only suggestive of a logical underlying structure. Four of the factors (F_1, F_{18}, F_{30}, F_{37}) loading highly on Dimension 1 were associated

Table 5.12

Factor Analysis Loadings

Dimension	Loading	i	Factor (F_i)
1	.8162	1	Relationship with EDP staff
	.8105	8	Perceived utility
	.6125	11	Expectations
	.6536	18	Attitude of the EDP staff
	.8599	30	Communications with EDP staff
	.8512	37	Technical competence of the EDP staff
2	.8654	19	Reliability
	.7077	21	Format of output
	.6834	27	Job effects
	.7996	28	Accuracy
	.7461	29	Precision
	.8464	36	Completeness
3	.7397	4	Organizational competition with EDP staff
	.7438	14	Degree of training
4	.6795	6	Timeliness
	.7300	17	Currency
	.6443	33	Feeling of control
5	.7542	26	Volume of output
6	.6390	2	Processing of change requests
	.7878	20	Top management involvement
	.5557	32	Time required for new development
7	.6493	25	Relevancy
8	.7184	7	Charge-back method of payment
	.6539	13	Security of data

with the EDP staff. The other two factors (F_8, F_{11}) apeared related to one another rather than to the other four. Dimension 2 involved factors (F_{19}, F_{21}, F_{28}, F_{29}, F_{36}) which are all associated with what might be termed the "quality of information products". The other factor (F_{27}) is not clearly related to the others. Other factor pairs which were considered to have a natural affinity were clustered on Dimension 4 (F_6, F_{17}) and Dimension 6 (F_2, F_{32}). The other factors included in Table 5.12 were not readily explained.

The confirmation of construct validity was less conclusive than either content or predictive validity; however, substantial evidence was presented to that end. It was felt that total confirmation of construct validity was beyond the scope of this research; yet, the development of the user satisfaction measurement instrument was a necessary accomplishment toward that objective.

SUMMARY

The user satisfaction measurement instrument was evaluated for the properties of reliability and validity. These two properties were considered fundamental to the achievement of the research objective. The evaluation included the administration of the instrument to two groups of subjects.

Reliability coefficients were calculated for each of the 39 factors. The coefficients reflected the proportion

of total variance in the factor scores attributable to measured individual differences. The high reliability coefficients, ranging from .7527 to .9828, indicated that the errors of measurement were insignificant. This evidence ratified the reliability property of the measurement instrument.

Three aspects of validity were examined. The support was stronger for content and predictive validity than for construct validity; however, each aspect implied the other. Total confirmation of validity was felt to be a matter of degree rather than a dichotomy of "is valid" or "is not valid". The evidence presented in this evaluation denoted all of the aspects of validity to a substantial degree. Further confirmation of the validity of the user satisfaction measurement instrument was expected to result from the use of the instrument in future research.

Chapter 6

SUMMARY, CONCLUSIONS, AND RECOMMENDATIONS

SUMMARY

The research undertaken for this study had two objectives. The first was the definition of the user satisfaction construct and the formulation of a measurement model to reflect that definition. The second objective was the development and evaluation of a measurement instrument to provide the operational means to measure the construct.

A literature review established that user satisfaction was an attitude construct with multiple dimensions. Therefore, user satisfaction was defined as <u>the sum of feelings or affective responses to distinguishable factors of the computer-based information products and services that are provided within the organization</u>. The measurement model to reflect this definition was specified by

$$S_i = \sum_{j=1}^{n} W_{ij} R_{ij}$$

where

S_i = Satisfaction of user i

W_{ij} = Importance weight of factor j for user i

R_{ij} = Raw score of factor j for user i

Implementation of this model imposed two requirements. One was the identification of the factors which comprised the domain of the user satisfaction construct. The second was the measurement of the user's attitudinal feelings toward those factors. The scaling methodologies commonly utilized in the measurement of attitudes were evaluated, and the semantic differential technique was selected as the most appropriate for measuring user satisfaction. Semantic differential scales were demonstrated to be interval scales which anchor a bipolar continuum with the zero point of attitude intensity located at the midpoint of the range of the scale sums. These metric properties conformed to the model requirements.

The factors which comprised the domain of the user satisfaction construct were tentatively identified through a literature review. This list of factors and their operational definitions were reviewed and supplemented by five independent judges. The factors identified in this manner were considered to be the "important" factors which influence a user's satisfaction. The list was defined to be complete if the probability exceeded .90 that any factor mentioned by a user in an interview was contained in the list. Thirty-two middle management users in eight different organizations were interviewed to elicit the factors which they considered important. A hypothesis test of the factors discussed in the interviews supported the completeness of

the factor list at the .01 level of significance. These 39 factors, defined in Appendix 3.8, constituted the user satisfaction construct domain.

The construction of the measurement instrument integrated the construct domain with the semantic differential methodology. The specific evaluation scales for each factor in the domain were defined by bipolar adjective pairs. Four adjective pairs (scales) for each factor were selected in a two-step Delphi approach in concert with five university professors. These four scales were coupled with an internal consistency scale and an importance weighting scale to operationalize the measurement of a user's feeling toward each factor. After an evaluation of the decisions of format, the scales were assembled into booklet form with appropriate instructions for completion to create the measurement instrument.

An evaluation of the measurement instrument commenced with the administration of the instrument to the 32 users who had participated in the initial interviews. Twenty-nine middle managers completed and returned the booklets. Their responses were analyzed both statistically and subjectively to substantiate the reliability and validity properties of the instrument. It was concluded that the results of this evaluation denoted a successful demonstration of the research purpose, the measurement of user satisfaction.

CONCLUSIONS

The general conclusions drawn from this study are that the research objectives were achieved. User satisfaction can be defined within a domain of factors, and the user's feelings toward those factors can be measured with the measurement instrument as constructed. The specific conclusions warranted by this study are enumerated and discussed as follows:

1. The user satisfaction construct was adequately defined by the 39 factors listed in Appendix 3.8. Thirty-two users in eight organizations were interviewed. During those interviews, each factor that was mentioned was identified as a factor important to that user. Multiple mentions of the same factor in a single interview were counted as only one mention. The total number of factors mentioned by the subjects was 638, an average of 19.9 factors per subject. Only 13 of the 638 factor mentions were factors not identified in the factor list shown in Appendix 3.8. This supported the hypothesis, at the .01 level of significance, that the probability exceeded .90 that a factor considered important by a user was included in the measurement process. The hypothesis implied that the preponderance of things that mattered to a user were measured by the instrument as defined.

2. Weighting of factor scores by importance ratings was unnecessary. The correlation coefficient for weighted

and unweighted scores was .9968. The explanation for the high correlation was revealed in a detailed examination of the subject responses. Important factors were typically rated more extremely on the scales than less important factors which were rated more neutrally. This "internal weighting" of the factors minimized the effect of the weighting function ascribed by the importance scale. This reduced the information value of the scale to the simple identification of factors considered directly important by an individual subject.

3. The measurement instrument was reliable. An analysis of variance approach was used to partition the variance obtained with a set of measured scores. The reliability coefficient was calculated for each factor as the proportion of the total variance attributable to "true variance". The coefficients, which ranged from .7527 to .9820, indicated that the variance attributable to measurement error was negligible. This implied that the variance in the set of scores was almost wholly accounted for by the measurement technique.

4. The measurement instrument was valid. Three aspects of validity were examined. Content validity was indicated subjectively by the definition of the construct domain and the careful application of the semantic differential methodology. In addition, the subject response structures exhibited the characteristics of homogeneity,

unidimensionality, and scale discrimination. These characteristics were analytically determined.

Predictive validity was verified by the correlation between the subject self-assessments of satisfaction and their measured scores. The Pearson product-moment correlation coefficient was .7899, significant at the .001 level. The linearity exhibited by the group means also followed the expected pattern. Another "known group" criterion was less conclusive. Subjects identified by an external judge only partially followed the expected scoring. This was attributed to erroneous assignment of subjects to groups and was considered less significant than the self-assessment results.

Construct validity was strongly suggested by the characteristics of content and predictive validity. It was further confirmed by the positive importance means ascribed to the factors by the subjects. Furthermore, the specific factors identified as the most important by the subjects appeared eminently logical. The factors which were rated dissatisfactory by a majority of the subjects agreed with the findings suggested in other studies. A factor analysis, however, was only suggestive of an expected underlying structure for the factor intercorrelations.

The evidence considered in entirety confirmed the validity of the measurement instrument. This implied that the subject attribute that was being measured reliably was

the attribute (construct) of user satisfaction.

5. The measurement instrument was objective. The rules for administration and scoring of the instrument were completely determined. Moreover, there was no verbalization required of the subject. Therefore, the instrument was amenable to cross-research comparison on a common basis.

6. The measurement metric was directly interpretable. Each factor score ranged from +3 to -3 with equidistant intervals associated with fixed responses (for example, +2 was associated with "quite satisfied"). Each satisfaction score ranged from +117 to -117 with the positive or negative sign indicating satisfaction or dissatisfaction, respectively. The intensity of the satisfaction or dissatisfaction was reflected by the magnitude of the score. This direct interpretation precluded the requirement to develop standard sample scores for comparison purposes.

7. The measurement instrument was economical. The user time to complete the instrument ranged from 15 to 25 minutes. This time could be reduced somewhat by the elimination of the interval consistency and/or importance scales (depending upon the measurement objective). The format of the instrument was designed to facilitate independent, unsupervised completion by the subjects. Scoring of the responses was conducive to straightforward input for computer-assisted analysis. The instrument was subject to rapid modification by the addition/deletion of

factors and/or scales. Although such modifications would lack the reliability and validity assessments of this study, thoughtful changes could be undertaken with minimal risk.

RECOMMENDATIONS

The results and conclusions of this study indicate several directions for additional research. The specific recommendations are enumerated and discussed as follows:

1. The validation of the measurement instrument could be extended. Any measurement instrument, especially a new one, benefits by multiple studies directed at validation. The accumulated evidence fosters refinement, improvement, and acceptance of the instrument. One conceivable approach to this type of research could be the identification and evaluation of organizations considered to have effective or ineffective EDP operations. Administration of the user satisfaction instrument to users in these organizations would provide a contrast to the a priori judgments. The organizations could possibly be identified from the major computer vendors' "showcase" and "problem" installations.

2. Each of the 39 construct factors could be extensively examined. This examination could lead to the identification of the structural dimensions and characteristics of each factor with an understanding of what leads to satisfaction. Such information would be useful in the

development of a performance plan for the EDP organizational unit.

3. The measurement instrument could be used to contrast user satisfaction structures with organizational structures (both EDP and corporate) and policy structures within the organizations. An understanding of the organizational and policy conditions which lead to greater user satisfaction could lead to better decisions in establishing those conditions.

4. The use of the measurement instrument could be integrated into an overall productivity model which includes both effectiveness and efficiency measures for the EDP unit. This would allow the setting of target goals for the EDP staff and the measurement of progress toward those goals.

5. The measurement instrument could be used to explore the dynamics of user satisfaction over time and circumstance. Thus, the effects of technological and other changes could be catalogued and evaluated. Some of the marginal effects that could be examined include distributed versus centralized processing, on-line versus batch customer support, and charge-back algorithms versus fixed allocation of costs. This research would be amenable to large sample studies in which other variables in addition to user satisfaction are collected by subject.

6. The measurement instrument could be used to establish comparative standards of user satisfaction that

are appropriate for varying circumstances. Although the user satisfaction metric is directly interpretable, standards would be useful for management comparisons. For example, if the average user satisfaction score in an organization is 40, the users may be classified as "slightly satisfied"; however, this "slightly satisfied" rating may be extremely low or high when compared to the average user scores of organizations of similar type and size, EDP budget, etc. The identification of appropriate categories and category stratifications would facilitate the establishment of such standards.

7. The measurement instrument could be adopted for any research requiring the quantification of the user satisfaction variable. The absence of any comparable instrument coupled with a growing interest in this research area offers an excellent opportunity. Many advantages would accrue by the widespread adoption of a single basis of research measurement. Researchers would not have to develop their own instruments, and cross-research comparison would be greatly facilitated. Such acceptance of the instrument could lead to a much richer and rapid assimulation of knowledge. That is ultimately one of the goals of all research.

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APPENDICES

Appendix 3.1

FACTOR IDENTIFICATION BY STUDY

An "X" in the following matrix identifies the factors that were discussed in the cited studies.

FACTOR IDENTIFICATION BY STUDY

	Top management involvement	Organizational competition with EDP unit	Priorities determination	Charge-back method of payment of services	Relationship with the EDP staff	Communication with the EDP staff	Technical competence of the EDP staff	Attitude of the EDP staff	Schedule of products and services	Time required for new development	Processing of change requests	Vendor support	Response/turnaround time	Mode of interface	Convenience of access	Accuracy	Timeliness	Precision	Reliability	Currency	Completeness	Format of output	Language	Volume of output	Relevancy	Error recovery	Security of data	Documentation	Expectations	Understanding of systems	Perceived utility	Confidence in systems	Feeling of participation	Feeling of control	Degree of training	Job effects
Churchill, et al	X		X			X							X				X					X			X											
Diebold						X																												X		
McKinsey and Co.	X				X																								X							
Hofer	X	X												X							X															X
Pitts	X	X	X		X	X			X		X													X	X				X		X			X		
Tiechroew						X																	X													
Stone, et al		X			X	X				X						X	X		X						X			X			X					
Adams, et al					X				X							X		X	X					X	X									X		
Colton	X		X		X	X	X	X		X			X				X		X			X							X	X	X	X				X
Cohutant	X	X	X	X	X	X		X	X	X			X		X	X	X														X					
Dearden, et al				X																											X					

	Pinnberg	Lucas (1973a)	Lucas (1973b)	Powers, et al	Gupta	Holland	Lucas (1974)	Schussel	Swanson	Tomeski	Adams
Top management involvement		X		X	X						
Organizational competition with EDP unit			X					X			
Priorities determination			X	X							
Charge-back method of payment of services											
Relationship with the EDP staff		X	X			X			X		
Communication with the EDP staff			X	X						X	
Technical competence of the EDP staff				X	X						
Attitude of the EDP staff											
Schedule of products and services								X	X		
Time required for new development											
Processing of change requests		X						X			
Vendor support	X										
Response/turnaround time	X					X			X		X
Mode of interface	X	X									
Convenience of access									X		
Accuracy	X	X						X	X		X
Timeliness		X							X		
Precision											X
Reliability									X		X
Currency		X									
Completeness	X							X			
Format of output		X	X						X		X
Language	X								X		
Volume of output		X					X				
Relevancy		X			X				X		X
Error recovery	X										
Security of data	X					X					
Documentation		X		X					X		
Expectations					X						
Understanding of systems	X		X								
Perceived utility	X	X			X	X		X	X		X
Confidence in systems				X	X						
Feeling of participation		X		X		X				X	
Feeling of control						X					X
Degree of training		X		X							
Job effects	X	X	X		X					X	

Appendix 3.2

CORRESPONDENCE WITH SUBJECTS

The following letters and enclosures were used to solicit each subject's participation in three phases of the research: initial interview, factor ranking, and questionnaire completion. The addresses are deliberately omitted. The enclosure for the first letter was a self-addressed postcard to allow the subject to decline to participate. The enclosures for the second letter were a list of factors specified in the subject's interview and the definitions for that specific set of factors. A sample factor list is shown; the factor definitions are omitted. The enclosure for the third letter was the measurement instrument shown in Appendix 4.1, and it is not repeated here. The letters have been reduced photographically.

ARIZONA STATE
UNIVERSITY ________ TEMPE, ARIZONA 85281

SCHOOL OF ENGINEERING
Industrial Engineering

February 20, 1976

I am an Arizona State University student currently working toward a Ph.D. degree in Industrial Engineering. I have initiated a research project to discover and to measure the factors which cause a user to be satisfied or dissatisfied with the computer-based information systems and services provided within an organization. The achievement of this research goal will result in the improvement of the systems provided for the users.

Your present position indicates that you could make a valuable contribution to this research effort. I would greatly appreciate your participation. Your involvement will consist of an interview to discuss your experiences with computer-based information services and two follow-up questionnaires. The time required is minimal in contrast to the benefits which may result.

Although no adverse effects are foreseen as a result of your participation, a project identification number will be used to protect the anonymity of the data collected. The link between the identity of you and your organization and the associated number will be known only to myself and my committee chairman, Dr. James E. Bailey.

I hope that you will agree to join in this research project. I will contact you via telephone to arrange an appointment unless you return the enclosed card declining the request. I will gladly answer any questions at that time. Thank you for your cooperation. I am looking forward to meeting you.

Sincerely,

Sammy W. Pearson

Enc.

dr

POSTCARD, FRONT AND REVERSE

STAMP

Sammy W. Pearson
1427 E. Verlea
Tempe, Arizona 85282

Number H5

I decline to participate in your project.

Reason:

ARIZONA STATE
UNIVERSITY TEMPE, ARIZONA 85281

SCHOOL OF ENGINEERING
Industrial Engineering

I want to convey my appreciation for your participation in the recent interview to support my research. The information that you provided is a valuable contribution toward the identification of factors which cause a user to be satisfied or dissatisfied with the computer-based information systems and services provided within an organization. I have reviewed the tape recording of the interview and have extracted the factors that you discussed at that time.

These factors are listed on the second page. I would now like for you to rank these factors in their order of importance as influences on your own satisfaction. A rank of one should be assigned to the factor that you consider the most important influence, rank two to the second most important, etc. Assign a unique rank to each factor. Operational definitions for each factor are provided for clarification of the terminology. Please return the ranked factors to me via the enclosed envelope.

Your cooperation in this project has made my task not only easy but also very pleasant. In that same spirit, I request that you respond promptly with the rankings so that the subsequent research phases can proceed apace. Thank you.

Sincerely,

Sammy W. Pearson

Enclosures

dr

Assign ranks 1 through 22 to each factor listed below. Rank 1 is assigned to the most important factor. Rank 22 is assigned to the least important factor. Each factor must be assigned a unique rank.

Ranking	Factor
3	Accuracy
18	Format of output
4	Reliability
20	Processing of change requests
5	Confidence in the systems
7	Job effects
2	Perceived utility
14	Feeling of participation
8	Understanding of systems
13	Technical competence of the EDP staff
1	Relevancy
6	Degree of training
15	Communication with the EDP staff
9	Documentation
16	Feeling of control
12	Error recovery
19	Expectations
21	Mode of interface
22	Priorities determination
17	Relationship with the EDP staff
10	Rate of change
11	Standardization of systems

RETURN THIS PAGE VIA THE ENCLOSED ENVELOPE

ARIZONA STATE
UNIVERSITY TEMPE, ARIZONA 85281
COLLEGE OF ENGINEERING AND APPLIED SCIENCES (602) 965-34[illegible]

Industrial Engineering

May 10, 1976

I want to convey my appreciation for your participation in my current research project. The information that you provided in your interview and the subsequent factor rankings have been a valuable contribution toward the identification of factors that cause a user to be satisfied or dissatisfied with the computer-based information systems and services provided within an organization.

The enclosed questionnaire has been designed to provide a more formal assessment of your feelings toward the computer-based support that is provided to you in your present position. Please, complete the questionnaire and return it to me via the enclosed envelope. The instructions are included in the booklet. The results will be accorded the same confidentiality as the previous actions.

It is imperative that I receive the completed questionnaire very soon. Therefore, I request that you respond no later than Friday, May 14. The time required to complete the questionnaire should be approximately 25 minutes. The quality of the research has been enhanced greatly by your cooperation. Thank you very much.

Sincerely,

Sammy W. Pearson

Enc.

dr

Appendix 3.3

BACKGROUND QUESTIONNAIRE AND CONSENT STATEMENT

The following questionnaire and consent statement were completed by each subject prior to the interview. The satisfaction scale shown on page two was on the reverse side of the questionnaire and was completed at the conclusion of the interview.

CONFIDENTIAL

Name ________________________________ Project Number __________

Office Address __________________________________ Phone _______

____

Home Address ____________________________________ Phone _______

____

Send research correspondence to ( ) office

( ) home

My functional area is: (check all that apply)

( ) Accounting
( ) Administration
( ) Finance
( ) Marketing
( ) Operations
( ) Personnel
( ) Planning/Budget
( ) Other __________

I have ( ) 0-3 / ( ) 4-6 / ( ) over 6 years experience using computer-based information products and services.

I use ( ) hard-copy output
( ) terminals
( ) computer-output microforms
(Check all that apply)

I consider myself a ( ) heavy / ( ) medium / ( ) light user of computer-based information products and services.

I hereby authorize this interview to be tape recorded. My participation is voluntary, and I understand that I may freely withdraw such participation at any time.

______________________________ Date ___________

CONFIDENTIAL

Extremely	Quite	Slightly	Equally	Slightly	Quite	Extremely

Satisfied: _______:_______:_______:_______:_______:_______:_______:Dissatisfied

Appendix 3.4

INTERVIEW GUIDELINES

INTERVIEW GUIDELINES

RECORDER OFF

****

Mr / Ms ______________,

This interview is being conducted as part of a research project to discover and to measure the factors leading to satisfaction or dissatisfaction with the computer-based information systems and services provided within an organization. As the cover letter explained, this interview is the first of several actions in which you will be asked to participate. You were selected because you are in a position to provide meaningful information about the research questions. The anonymity of the data collected from you will be protected by the methods described in the cover letter. Do you have any questions?

****

Before we begin, I would like for you to fill out this brief background form. The information will be used to insure that the sample distribution is adequate. I would also like for you to read and to sign the consent form at the bottom of the page. This simply indicates your willingness to participate freely and gives me permission to record our conversations.

****

FILL OUT BACKGROUND FORM / CONSENT FORM

RECORDER ON

***

Do you have any objections to recording this interview?

Now, I would like for you to think of a time when you felt especially satisfied or dissatisfied with the computer-based information services or products that you were receiving. This includes any time during your working career. Please, describe that situation for me.

***

PROBES

1. What did these events mean to you?
2. Can you tell me more precisely why you felt the way you did at the time?
3. How did it specifically affect you?
4. Can you give me an example of how it affected your job?
5. How long did it last?
6. Did anything occur that changed the situation and your feelings?
7. Why did that (satisfy/dissatisfy) you?
8. How do you mean?
9. If that happened today, would it have the same effect?
10. Was there anything during that period that (displeased/pleased) you?

***

Now that you have described a time when you felt especially __________ with your computer-based support, will you describe a time when you were especially ________.

***

REPEAT PROBING AND INCIDENTS

How do you feel about the computer-based information support you currently receive?

****

PROBE

****

Considering everything with regard to the computer support you now receive, where on this satisfaction scale would you consider yourself?

****

MARK SATISFACTION SCALE

****

RECORDER OFF

****

Thank you very much for this interview. You will receive a follow-up on the results within two weeks. At that time you will be asked to rank the factors which you have talked about in this interview in terms of importance. I would appreciate it very much if you would respond immediately when you receive it to help conclude the research within my time limits. It should take no more than 10 minutes to respond. I appreciate your cooperation.

Appendix 3.5

DATA EXTRACTION SYLLABUS

DATA EXTRACTION SYLLABUS

Part I : Purpose

This syllabus provides definitions and procedures for extracting data from tape recordings of personal interviews. The data of interest are those factors which influence a respondent to be satisfied or dissatisfied with the computer-based information products and services provided within his organization. The objective of this data extraction procedure is the development of a list of factors for each individual respondent that is based solely on the interview statements.

Part II : General Definitions

Factor: Any identifiable element which influences or contributes to a user's satisfaction or dissatisfaction with the computer-based information support that is provided within an organization.

Thought Unit: A statement about a single event or condition that led to a feeling of satisfaction or dissatisfaction, a single characterization of a feeling, or a description of a single event.

EDP: Electronic Data Processing.

PART III: FACTOR DEFINITIONS

Top management involvement: The positive or negative degree of interest, enthusiasm, support, or participation of any management level above the respondent's own level toward computer-based information systems or services or toward the computer staff which supports them.

Organizational competition with the EDP unit: The contention between the respondent's organizational unit and the EDP unit when vying for organizational resources or for responsibility for success or failure of computer-based information systems or services of interest to both parties.

Organizational Position of EDP function: The hierarchical relationship of the EDP function to the overall organizational structure.

Priorities determination: Policies and procedures which establish precedence for the allocation of EDP resources and services between different organizational units and their requests.

Charge-back method of payment for services: The schedule of charges and the procedures for assessing users on a pro rate basis for the EDP resources and services that they utilize.

Relationship with the EDP staff: The manner and methods of interaction, conduct, and association between the user and EDP staff.

Communication with the EDP staff: The manner and methods of information exchange between the user and the EDP staff.

Technical Competence of the EDP staff: The computer technology skills and expertise exhibited by the EDP staff.

Attitude of the EDP staff: The willingness and commitment of the EDP staff to subjugate external, professional goals in favor of organizationally directed goals and tasks.

Schedule of products and services: The EDP center time-table for production of information system outputs and for porvision of computer-based services.

Time required for new development: The elapsed time between the user's request for new applications and the design, development, and/or implementation of the application systems by the EDP staff.

Processing of change requests: The manner, method, and required time with which the EDP staff responds to user requests for changes in existing computer-based information systems or services.

Vendor support: The type and quality of the service rendered by a vendor, either directly or indirectly, to the user to maintain the hardware or software required by that user. A vendor is distinguished by his external organizational status.

Response/turnaround time: The elapsed time between a user-initiated request for service or action and a reply to that request. Response time generally refers to the elapsed time for a terminal type request or entry. Turnaround time generally refers to the elapsed time for execution of a program submitted or requested by a user and the return of the output to that user.

Mode of interface: The method and medium by which a user inputs data to and receives output from the EDP center.

Convenience of access: The ease or difficulty with which the user may act to utilize the capability of the computer systems.

Quality of systems: The degree of excellence of the computer-based information systems as manifested in the six attributes of the system outputs - accuracy, timeliness, precision, reliability, currency, and completeness.

Accuracy: The correctness of the output information.

Timeliness: The availability of the output information at a time suitable for its use.

Precision: The variability of the output information from that which it purports to measure.

Reliability: The consistency and dependability of the output information.

Currency: The age of the output information.

Completeness: The comprehensiveness of the output information content.

Flexibility: The capacity of the information system to change or to adjust in response to new conditions, demands, or circumstances.

Format of output: The material design of the layout and display of the output contents.

Language: The set of vocabulary, syntax, and grammatical rules used to interact with the computer systems.

Volume of output: The amount of information conveyed to a user from computer-based systems. This is expressed by not only the number of reports or outputs but also by the voluminousness of the output contents.

Relevancy: The degree of congruence between what the user wants or requires and what is provided by the information products and services.

Error recovery: The methods and policies governing correction and rerun of system outputs that are incorrect.

Security of data: The safeguarding of data from misappropriation or unauthorized alteration or loss.

Documentation: The recorded description of an information system. This includes formal instructions for the utilization of the system.

Expectations: The set of attributes or features of the computer-based information products or services that a user considers reasonable and due from the computer-based information support rendered within his organization.

Understanding of systems: The degree of comprehension that a user possesses about the computer-based information systems or services that are provided to him.

Perceived utility: The user's judgment about the relative balance between the cost and the considered usefulness of the computer-based information products or services that are provided. The costs include any costs related to providing the resource, including money, time, manpower, and opportunity. The usefulness includes any benefits that the user believes that he derives from the support.

Confidence in the systems: The user's feelings of assurance or certainty about the systems which support him.

Feeling of participation: The degree of involvement and commitment which the user shares with the EDP staff and others toward the functioning of the computer-based information systems and services.

Degree of training: The amount of specialized instruction and practice that is afforded to the user to increase his proficiency in utilizing the computer capability that is available to him.

Job effects: The changes in job freedom and job performance that are ascertained by the user as resulting from modifications induced by the computer-based information systems and services.

Feeling of control: The user's awareness of his power or lack of power to regulate, direct or dominate the development, alteration, and/or execution of the computer-based information systems or services which serve him in his perceived function.

Part IV : Procedure

1. Listen to the entire tape and concentrate on recognizing thought units as they are expressed by the respondent.

2. Rewind the tape.

3. Again, listen to the tape, but stop anytime that a thought unit is expressed.

4. If the factor expressed by the thought unit is clear, write down the factor directly. If the factor is not clear, write down the thought unit verbatim.

5. Evaluate the thought unit before proceeding with the tape. However, a short portion of the interview beyond the thought unit in question may clarify it. Decide on a factor that the thought unit expresses and write it down.

6. Proceed with the tape and repeat steps 3-5 until the interview portion is completed.

7. Divide the list of factors that were extracted from the tape into two groups. Those factors that were defined in Part III of this syllabus are listed in the first group using the nomenclature as defined. The second group of factors contain those factors not defined in this syllabus. The nomenclature of these factors must be devised to convey understanding about the undefined factors. Duplicate factors are listed only once in the final two groups.

8. This completes the data extraction.

Appendix 3.6

FACTORS MENTIONED BY SUBJECT

An "X" in the following matrix identifies the specific factors mentioned by a subject during the subject's interview.

FACTORS MENTIONED BY SUBJECT

Subjects

	A1	A2	A3	A4	B1	B3	C1	C2	C3	C4	C5	D1	D2	D3	E1	E2	E3	E4	F1	F2	F3	F4	F5	G1	G2	G3	G4	H1	H2	H3	H4	H5
Top management involvement						X						X		X	X					X												X
Organizational competition with EDP unit					X										X				X		X											
Priorities determination				X	X	X	X		X	X	X	X	X		X	X	X	X	X	X			X	X	X	X	X	X		X	X	X
Charge-back method of payment of services																						X							X			X
Organizational position of the EDP function					X			X	X	X	X		X	X							X	X										X
Relationship with the EDP staff	X	X	X	X	X	X		X	X			X	X	X	X	X	X	X	X		X			X	X		X		X		X	X
Communication with the EDP staff				X	X	X	X	X	X	X	X	X	X	X	X	X		X		X	X	X		X	X		X	X	X		X	X
Technical competence of the EDP staff	X			X	X	X	X		X	X	X	X	X	X		X	X	X	X	X		X	X	X	X			X	X			X
Attitude of the EDP staff	X		X		X		X		X		X	X	X	X	X	X		X	X	X	X	X	X		X		X		X			X
Schedule of products and services			X		X		X			X			X			X	X		X			X	X	X						X		X
Time required for new development					X	X	X	X	X	X	X		X	X		X	X		X	X	X	X	X		X	X			X		X	X
Processing of change requests	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X		X		X	X	X	X		X	X	X	X	X	X		X	X
Vendor support					X			X									X				X		X								X	
Response/turnaround time			X		X		X							X	X	X	X		X	X	X		X	X		X	X	X		X		X
Mode of interface	X	X	X	X	X	X	X		X	X	X	X	X	X	X	X	X	X		X		X	X	X		X	X	X		X		X
Convenience of access		X					X	X						X	X	X	X	X		X		X	X	X	X	X				X	X	X
Accuracy	X	X	X	X		X			X			X		X	X	X	X	X	X	X	X	X	X	X	X	X		X	X	X		X
Timeliness								X	X		X		X		X	X	X	X	X	X		X		X				X		X		X

Subjects

	A1	A2	A3	A4	B1	B3	C1	C2	C3	C4	C5	D1	D2	D3	E1	E2	E3	E4	F1	F2	F3	F4	F5	G1	G2	G3	G4	H1	H2	H3	H4	H5
Precision										X															X	X			X			
Reliability	X			X	X		X	X	X							X	X		X	X	X		X		X			X				X
Currency			X		X		X					X	X	X			X						X		X	X	X					
Completeness		X	X		X	X	X	X	X	X	X		X				X	X			X	X	X	X	X	X	X	X	X	X	X	X
Flexibility	X		X		X		X	X		X		X	X		X					X	X				X	X		X	X		X	X
Format of output	X	X		X		X	X						X				X	X	X	X	X				X		X	X	X	X	X	
Language											X					X							X		X			X		X	X	
Volume of output	X				X	X		X		X								X			X			X	X	X					X	
Relevancy	X	X	X	X	X	X		X	X		X	X	X	X	X	X	X		X		X	X			X	X	X			X	X	
Error recovery	X	X		X			X				X				X		X	X			X											
Security of data	X				X	X								X						X									X	X		
Documentation		X	X	X	X	X		X				X		X		X	X		X						X			X				X
Expectations		X	X	X	X	X	X	X	X		X	X	X	X	X		X	X		X		X	X	X	X		X		X			X
Understanding of systems	X	X	X	X	X	X			X		X	X	X	X	X	X		X		X	X	X		X	X	X		X	X			
Perceived utility		X		X	X	X	X	X	X		X	X	X	X	X	X	X				X	X	X		X	X	X	X	X	X	X	X
Confidence in systems				X	X										X		X		X	X	X		X		X	X			X			
Feeling of participation	X		X	X	X	X			X	X			X	X	X			X	X	X	X					X	X	X				X
Feeling of control	X		X	X	X	X		X	X	X	X	X	X	X	X	X			X	X		X	X			X			X			X
Degree of training		X		X	X				X				X		X										X		X	X	X	X	X	
Job effects	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X		X	X	X	X	X	X	X		

Subjects

	A1	A2	A3	A4	B1	B3	C1	C2	C3	C4	C5	D1	D2	D3	E1	E2	E3	E4	F1	F2	F3	F4	F5	G1	G2	G3	G4	H1	H2	H3	H4	H5
Challenge	X																															
Rate of Change				X																								X				
Standardization of systems				X																												
Complexity of system																					X											
Volume of input																															X	
Back-up facilities					X																											
Vendor selection					X												X															
Integration of systems														X												X	X		X			

Appendix 3.7

FACTOR RANKINGS BY SUBJECT

The factors mentioned during a subject's interview were ranked in order of importance. The most important factor was assigned the value one. The following matrix presents the factor rankings by subject. Subject B3 declined to rank the factors.

FACTOR RANKINGS BY SUBJECT

	A1	A2	A3	A4	B1	B3	C1	C2	C3	C4	C5	D1	D2	D3	E1	E2	E3	E4	F1	F2	F3	F4	F5	G1	G2	G3	G4	H1	H2	H3	H4	H5
Top management involvement												1		3	22					21												15
Organizational competition with EDP unit					30										21				11		16											
Priorities determination				22	10		10		3	4	11	6	9		20	3	11	6	5	11			11	8	14	12	6	8		14	2	2
Charge-back method of payment of services																						19							21			14
Organizational position of the EDP function					24			18	15	12	17		6	4							21	18										17
Relationship with the EDP staff	6	4	12	17	29			5	5			4	15	23	16	2	18	10	1		3			16	20		13		18		12	5
Communication with the EDP staff				15	22		16	6	2	1	4	3	1	17	15	15		11		20	9	2		15	22		16	15	13		5	16
Technical competence of the EDP staff	2			13	27		6		1	7	9	5	3	6		9	7	12	3	6		6	3	11	5			11	10			18
Attitude of the EDP staff	3		11		25		15		6		2	2	5	18	14	4		14	2	18	2	4	7		21		17		9			4
Schedule of products and services			15		14		19			13			18			11	15		14			11	15	13						13		9
Time required for new development					5		5	15	11	6	14		8	12		12	17		12	5	19	1	9		4	17			15		6	7
Processing of change requests	12	15	9	20	6		11	14	18	5	7	10	7	19	6		13		13	3	22	8		12	9	8	15	13	16		7	6
Vendor support					28			17									21				23		16								14	
Response/turnaround time			10		2		9							15	5	1	10		10	13	18		10	5		18	4	10		6		8
Mode of interface	16	13	17	21	12		17		13	8	16	15	14	8	18	20	16	8		19		16	18	10		19	11	14		15		20
Convenience of access		7					7	8						16	7	8	14	13		1		3	5	9	10	15				4	8	19
Accuracy	5	5	1	3					8			8		13	4	7	1	1	16	10	13	14	1	1	1	1		3	12	1		12
Timeliness								1	10		1		12		3	6	3	2	17	8		12		2				5		2		10

	A1	A2	A3	A4	B1	B3	C1	C2	C3	C4	C5	D1	D2	D3
Precision										10				
Reliability	8			4	3		1	2	9					
Currency			4		1		3					12	13	11
Completeness		1	3		4		4	11	12	2	13		23	
Flexibility	4		7		7		2	13		3		14	10	
Format of output	17	3		18			8						22	
Language											18			
Volume of output	14				16			16		15				
Relevancy	7	2	2	1	8			12	4		3	11	17	10
Error recovery	13	6		12			12				5			
Security of data	18				19									20
Documentation		9	5	9	21			7				9		7
Expectations		11	14	19	11		13	9	21		15	13	16	21
Understanding of systems	9	8	6	8	17				17		10	7	20	1
Perceived utility		12		2	13		14	3	7		8	16	19	9
Confidence in systems				5	9									
Feeling of participation	1		13	14	26				19	9			4	5
Feeling of control	15		8	16	23			4	20	14	6	17	2	22
Degree of training		14		6	15				16				21	
Job effects	11	10	16	7	18		18	10	14	11	12	18	11	14

	E1	E2	E3	E4	F1	F2	F3	F4	F5	G1	G2	G3	G4	H1	H2	H3	H4	H5
Precision											12	9			1			
Reliability		5	2		18	9	5		2		13			4				11
Currency			12						12		6	7	12					
Completeness			6	4			4	15	6	7	3	4	2	7	11	3	1	13
Flexibility	2					2	12				2	5		6	2		4	3
Format of output			19	5	19	14	14				23		14		19	7	10	
Language		19							17		24			17		10	16	
Volume of output				17			20			6	25	20		19			15	
Relevancy	1	16	8		6		9	13			7	13	1			5	3	
Error recovery	8		5	3			17											
Security of data						16									8	9		
Documentation		17	4		9						11			12				21
Expectations	19		23	16		17		7	14	14	17		8		7			24
Understanding of systems	9	18		7		22	11	10		3	15	11		18	14			
Perceived utility	17	10	24				8	9	13		18	3	3	2	3	11	11	22
Confidence in systems	12		9		4	4	1		4		16	6			6			
Feeling of participation	11			9	7	12	6					16	10	20				1
Feeling of control	23	13			8	7		5	8			14			5			23
Degree of training	10										19		5	16	20	8	13	
Job effects	13	14	22	15	15	15	15	17		4	8	10	9	1	4	12		

	A1	A2	A3	A4	B1	B3	C1	C2	C3	C4	C5	D1	D2	D3	E1	E2	E3	E4	F1	F2	F3	F4	F5	G1	G2	G3	G4	H1	H2	H3	H4	H5
Challenge	10																															
Rate of Change				10																								9				
Standardization of systems				11																												
Complexity of system																					10											
Volume of input																															9	
Back-up facilities					20																											
Vendor selection					31												20															
Integration of systems														2												2	7		17			

Appendix 3.8

FACTOR LISTING AND DEFINITIONS

The following fold-out list of factors is provided for the reader's convenience. The list is supplemented by the factor definitions.

FACTORS

1. Relationship with the EDP staff
2. Processing of change requests
3. Mode of interface
4. Organizational competition with EDP unit
5. Confidence in systems
6. Timeliness
7. Charge-back method of payment for services
8. Perceived utility
9. Vendor support
10. Language
11. Expectations
12. Error recovery
13. Security of data
14. Degree of training
15. Understanding of systems
16. Feeling of participation
17. Currency
18. Attitude of the EDP staff
19. Reliability
20. Top management involvement
21. Format of output
22. Response/turnaround time
23. Priorities determination
24. Convenience of access
25. Relevancy
26. Volume of output
27. Job effects
28. Accuracy
29. Precision
30. Communication with the EDP staff
31. Organizational position of the EDP function
32. Time required for new development
33. Feeling of control
34. Schedule of products and services
35. Documentation
36. Completeness
37. Technical competence of the EDP staff
38. Flexibility
39. Integration of systems

<u>Top management involvement</u>: The positive or negative degree of interest, enthusiasm, support, or participation of any management level above the user's own level toward computer-based information systems or services or toward the computer staff which supports them.

<u>Organizational competition with the EDP unit</u>: The contention between the respondent's organizational unit and the EDP unit when vying for organizational resources or for responsiblity for success or failure of computer-based information systems or services of interest to both parties.

<u>Priorities determination</u>: Policies and procedures which establish precedence for the allocation of EDP resources and services between different organizational units and their requests.

<u>Charge-back method of payment for services</u>: The schedule of charges and the procedures for assessing users on a pro rata basis for the EDP resources and services that they utilize.

<u>Relationship with the EDP staff</u>: The manner and methods of interaction, conduct, and association between the user and the EDP staff.

<u>Communication with the EDP staff</u>: The manner and methods of information exchange between the user and the EDP staff.

<u>Technical competence of the EDP staff</u>: The computer technology skills and expertise exhibited by the EDP staff.

<u>Attitude of the EDP staff</u>: The willingness and commitment of the EDP staff to subjugate external, professional goals in favor of organizationally directed goals and tasks.

<u>Schedule of products and services</u>: The EDP center time-table for production of information system outputs and for provision of computer-based services.

<u>Time required for new development</u>: The elapsed time between the user's request for new applications and the design, development, and/or implementation of the applications systems by the EDP staff.

<u>Processing of change requests</u>: The manner, method, and required time with which the EDP staff responds to user requests for changes in existing computer-based information systems or services.

<u>Vendor support</u>: The type and quality of the service rendered by a vendor, either directly or indirectly, to the user to maintain the hardware or software required by that user. A vendor is distinguished by his external organizational status.

Response/turnaround time: The elapsed time between a user-initiated request for service or action and a reply to that request. Response time generally refers to the elapsed time for a terminal type request or entry. Turnaround time generally refers to the elapsed time for execution of a program submitted or requested by a user and the return of the output to that user.

Mode of interface: The method and medium by which a user inputs data to and receives output from the EDP center.

Convenience of access: The ease or diffficulty with which the user may act to utilize the capability of the computer systems.

Accuracy: The correctness of the output information.

Timeliness: The availability of the output information at a time suitable for its use.

Precision: The variability of the output information from that which it purports to measure.

Reliability: The consistency and dependability of the output information.

Currency: The age of the output information.

Completeness: The comprehensiveness of the output information content.

Format of output: The material design of the layout and display of the output contents.

Language: The set of vocabulary, syntax, and grammatical rules used to interact with the computer systems.

Volume of output: The amount of information conveyed to a user from computer-based systems. This is expressed by not only the number of reports or outputs but also by the voluminousness of the output contents.

Relevancy: The degree of congruence between what the user wants or requires and what is provided by the information products and services.

Error recovery: The methods and policies governing correction and rerun of system outputs that are incorrect.

Security of data: The safeguarding of data from misappropriation or unauthorized alteration or loss.

Documentation: The recorded description of an information system. This includes formal instructions for the utilization of the system.

Expectations: The set of attributes or features of the computer-based information products or services that a user considers reasonable and due from the computer-based information support rendered within his organization.

Understanding of systems: The degree of comprehension that a user possesses about the computer-based informations systems or services that are provided.

Perceived utility: The user's judgment about the relative balance between the cost and the considered usefulness of the computer-based informaton products or services that are provided. The costs include any costs related to providing the resource, including money, time, manpower, and opportunity. The usefulness includes any benefits that the user believes to be derived from the support.

Confidence in the systems: The user's feelings of assurance or certainty about the systems provided.

Feeling of participation: The degree of involvement and commitment which the user shares with the EDP staff and others toward the functioning of the computer-based information systems and services.

Feeling of control: The user's awareness of the personal power or lack of power to regulate, direct or dominate the development, alteration, and/or execution of the computer-based information systems or services which serve the user's perceived function.

Degree of training: The amount of specialized instruction and practice that is afforded to the user to increase the user's proficiency in utilizing the computer capability that is available.

Job effects: The changes in job freedom and job performance that are ascertained by the user as resulting from modifications induced by the computer-based information systems and services.

Organizational Position of the EDP Function: The hierarchical relationship of the EDP function to the overall organizational structure.

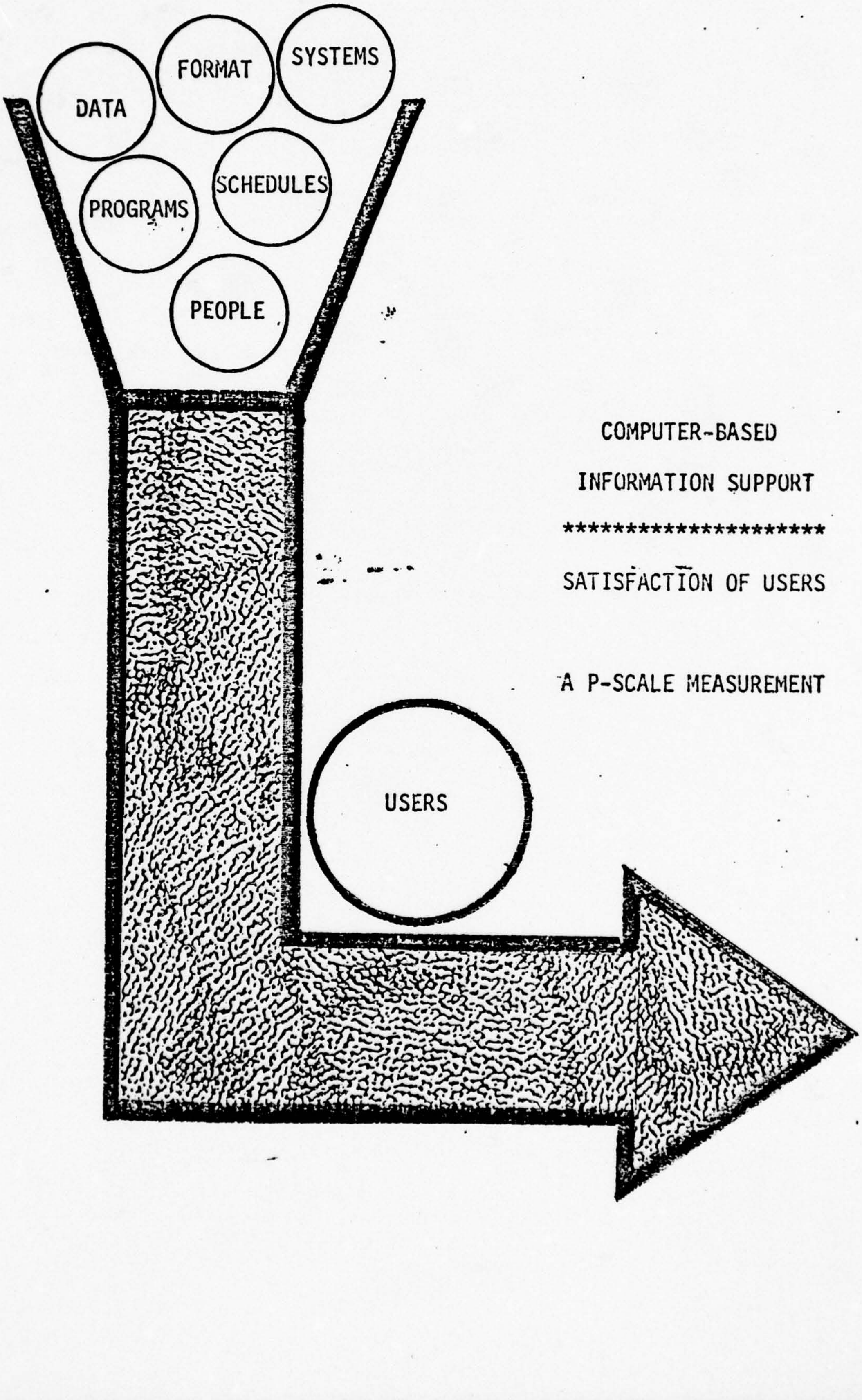
Flexibility of Systems: The capacity of the information system to change or to adjust in response to new conditions, demands, or circumstances.

<u>Integration of systems</u>: The ability of systems to communicate/transmit data between systems servicing different functional areas.

Appendix 4.1

USER SATISFACTION MEASUREMENT INSTRUMENT

The following pages are reproductions of the pages of the user satisfaction measurement instrument. The actual instrument is in booklet form.



COMPUTER-BASED

INFORMATION SUPPORT

****

SATISFACTION OF USERS

A P-SCALE MEASUREMENT

To Research Participants:

The purpose of this study is to measure how *you* feel about certain aspects of the computer-based information products and services that are provided to you in your present position.

On the following pages you will find different factors, each related to some aspect of your computer-based support. You are to rate each factor on the descriptive scales that follow it, based on your evaluation of the factor.

A separate scale is provided for you to express how *important or unimportant* each factor is to you.

The scale positions are defined as follows:

term X :___:___:___:___:___:___:___: term Y
(1) (2) (3) (4) (5) (6) (7)

(1) *extremely* X	(5) *slightly* Y
(2) *quite* X	(6) *quite* Y
(3) *slightly* X	(7) *extremely* Y

(4) *neither* X *nor* Y;*equally* X *or* Y;*does not apply*

INSTRUCTIONS

1. Check each scale in the position that describes *your* evaluation of the factor being judged.
2. Check *every* scale, do not omit any.
3. Check *only one* position for each scale.
4. Check in the space, not between spaces.
5. Work rapidly. Rely on your first impressions.

THIS, NOT THIS
:_X_:___X___:

The final page is provided for any comments that you wish to make. Thank you very much for your cooperation. Return this booklet via the enclosed envelope.

Sincerely,

Sammy W Pearson

JUDGE THE FACTORS

BASED ON

<u>YOUR</u>

FEELINGS

1 | Relationship with the EDP* staff

harmonious :___:___:___:___:___:___:___: dissonant

good :___:___:___:___:___:___:___: bad

cooperative :___:___:___:___:___:___:___: uncooperative

candid :___:___:___:___:___:___:___: deceitful

satisfactory :___:___:___:___:___:___:___: unsatisfactory

To me, this factor is

important :___:___:___:___:___:___:___: unimportant

2 | Processing of requests for changes to existing systems

fast :___:___:___:___:___:___:___: slow

timely :___:___:___:___:___:___:___: untimely

simple :___:___:___:___:___:___:___: complex

flexible :___:___:___:___:___:___:___: rigid

satisfactory :___:___:___:___:___:___:___: unsatisfactory

To me, this factor is

important :___:___:___:___:___:___:___: unimportant

*EDP: Electronic Data Processing

3	Means of input/output with the EDP center

convenient :___:___:___:___:___:___:___: inconvenient

clear :___:___:___:___:___:___:___: hazy

efficient :___:___:___:___:___:___:___: inefficient

organized :___:___:___:___:___:___:___: disorganized

satisfactory :___:___:___:___:___:___:___: unsatisfactory

To me, this factor is

important :___:___:___:___:___:___:___: unimportant

4	Interdepartmental competition with the EDP unit

productive :___:___:___:___:___:___:___: destructive

rational :___:___:___:___:___:___:___: emotional

low :___:___:___:___:___:___:___: high

harmonious :___:___:___:___:___:___:___: dissonant

satisfactory :___:___:___:___:___:___:___: unsatisfactory

To me, this factor is

important :___:___:___:___:___:___:___: unimportant

5	Confidence in systems

high :___:___:___:___:___:___:___: low

strong :___:___:___:___:___:___:___: weak

definite :___:___:___:___:___:___:___: uncertain

good :___:___:___:___:___:___:___: bad

satisfactory :___:___:___:___:___:___:___: unsatisfactory

To me, this factor is

important :___:___:___:___:___:___:___: unimportant

6	Timeliness of output information

timely :___:___:___:___:___:___:___: untimely

reasonable :___:___:___:___:___:___:___: unreasonable

consistent :___:___:___:___:___:___:___: inconsistent

punctual :___:___:___:___:___:___:___: tardy

satisfactory :___:___:___:___:___:___:___: unsatisfactory

To me, this factor is

important :___:___:___:___:___:___:___: unimportant

7	Charge-back method of payment for services

just :___:___:___:___:___:___:___: unjust

reasonable :___:___:___:___:___:___:___: unreasonable

consistent :___:___:___:___:___:___:___: inconsistent

known :___:___:___:___:___:___:___: unknown

satisfactory :___:___:___:___:___:___:___: unsatisfactory

To me, this factor is

important :___:___:___:___:___:___:___: unimportant

8	Perceived utility (worth versus cost)

high :___:___:___:___:___:___:___: low

positive :___:___:___:___:___:___:___: negative

sufficient :___:___:___:___:___:___:___: insufficient

useful :___:___:___:___:___:___:___: useless

satisfactory :___:___:___:___:___:___:___: unsatisfactory

To me, this factor is

important :___:___:___:___:___:___:___: unimportant

9	Vendor support of hardware and software

skilled :___:___:___:___:___:___:___: bungling

sufficient :___:___:___:___:___:___:___: unsufficient

eager :___:___:___:___:___:___:___: indifferent

consistent :___:___:___:___:___:___:___: inconsistent

satisfactory :___:___:___:___:___:___:___: unsatisfactory

To me, this factor is

important :___:___:___:___:___:___:___: unimportant

10	Computer language used to interact with systems

simple :___:___:___:___:___:___:___: complex

powerful :___:___:___:___:___:___:___: weak

easy :___:___:___:___:___:___:___: difficult

easy-to-use :___:___:___:___:___:___:___: hard-to-use

satisfactory :___:___:___:___:___:___:___: unsatisfactory

To me, this factor is

important :___:___:___:___:___:___:___: unimportant

11	Expectations (expected versus actual level of computer-based support)

pleased :___:___:___:___:___:___:___: displeased

high :___:___:___:___:___:___:___: low

definite :___:___:___:___:___:___:___: uncertain

optimistic :___:___:___:___:___:___:___: pessimistic

satisfactory :___:___:___:___:___:___:___: unsatisfactory

To me, this factor is

important :___:___:___:___:___:___:___: unimportant

12	Correction of errors

fast :___:___:___:___:___:___:___: slow

superior :___:___:___:___:___:___:___: inferior

complete :___:___:___:___:___:___:___: incomplete

simple :___:___:___:___:___:___:___: complex

satisfactory :___:___:___:___:___:___:___: unsatisfactory

To me, this factor is

important :___:___:___:___:___:___:___: unimportant

13	Security of data

secure :___:___:___:___:___:___:___: unsecure

good :___:___:___:___:___:___:___: bad

definite :___:___:___:___:___:___:___: uncertain

complete :___:___:___:___:___:___:___: incomplete

satisfactory :___:___:___:___:___:___:___: unsatisfactory

To me, this factor is

important :___:___:___:___:___:___:___: unimportant

14	Degree of EDP training provided to users

complete :___:___:___:___:___:___:___: incomplete

sufficient :___:___:___:___:___:___:___: insufficient

high :___:___:___:___:___:___:___: low

superior :___:___:___:___:___:___:___: inferior

satisfactory :___:___:___:___:___:___:___: unsatisfactory

To me, this factor is

important :___:___:___:___:___:___:___: unimportant

15	Understanding of systems

high :___:___:___:___:___:___:___: low

sufficient :___:___:___:___:___:___:___: insufficient

complete :___:___:___:___:___:___:___: incomplete

easy :___:___:___:___:___:___:___: hard

satisfactory :___:___:___:___:___:___:___: unsatisfactory

To me, this factor is

important :___:___:___:___:___:___:___: unimportant

16	Feeling of participation

positive :___:___:___:___:___:___:___: negative

encouraged :___:___:___:___:___:___:___: repelled

sufficient :___:___:___:___:___:___:___: insufficient

involved :___:___:___:___:___:___:___: uninvolved

satisfactory :___:___:___:___:___:___:___: unsatisfactory

To me, this factor is

important :___:___:___:___:___:___:___: unimportant

17	Currency (up-to-dateness) of the output information

good :___:___:___:___:___:___:___: bad

timely :___:___:___:___:___:___:___: untimely

adequate :___:___:___:___:___:___:___: inadequate

reasonable :___:___:___:___:___:___:___: unreasonable

satisfactory :___:___:___:___:___:___:___: unsatisfactory

To me, this factor is

important :___:___:___:___:___:___:___: unimportant

18	Attitude of the EDP staff

user-oriented :___:___:___:___:___:___:___: self-centered

cooperative :___:___:___:___:___:___:___: belligerent

courteous :___:___:___:___:___:___:___: discourteous

positive :___:___:___:___:___:___:___: negative

satisfactory :___:___:___:___:___:___:___: unsatisfactory

To me, this factor is

important :___:___:___:___:___:___:___: unimportant

19	Reliability of output information

consistent :___:___:___:___:___:___:___: inconsistent

high :___:___:___:___:___:___:___: low

superior :___:___:___:___:___:___:___: inferior

sufficient :___:___:___:___:___:___:___: insufficient

satisfactory :___:___:___:___:___:___:___: unsatisfactory

To me, this factor is

important :___:___:___:___:___:___:___: unimportant

20	Top management involvement in EDP activities

strong :___:___:___:___:___:___:___: weak

consistent :___:___:___:___:___:___:___: inconsistent

good :___:___:___:___:___:___:___: bad

significant :___:___:___:___:___:___:___: insignificant

satisfactory :___:___:___:___:___:___:___: unsatisfactory

To me, this factor is

important :___:___:___:___:___:___:___: unimportant

21	Format of output

good :___:___:___:___:___:___:___: bad

simple :___:___:___:___:___:___:___: complex

readable :___:___:___:___:___:___:___: unreadable

useful :___:___:___:___:___:___:___: useless

satisfactory :___:___:___:___:___:___:___: unsatisfactory

To me, this factor is

important :___:___:___:___:___:___:___: unimportant

22	Response/turnaround time

fast :___:___:___:___:___:___:___: slow

good :___:___:___:___:___:___:___: bad

consistent :___:___:___:___:___:___:___: inconsistent

reasonable :___:___:___:___:___:___:___: unreasonable

satisfactory :___:___:___:___:___:___:___: unsatisfactory

To me, this factor is

important :___:___:___:___:___:___:___: unimportant

23	Determination of priorities for allocation of EDP resources

fair :___:___:___:___:___:___:___: unfair

consistent :___:___:___:___:___:___:___: inconsistent

just :___:___:___:___:___:___:___: unjust

precise :___:___:___:___:___:___:___: vague

satisfactory :___:___:___:___:___:___:___: unsatisfactory

To me, this factor is

important :___:___:___:___:___:___:___: unimportant

24	Convenience of access (to utilize the computer capability)

convenient :___:___:___:___:___:___:___: inconvenient

good :___:___:___:___:___:___:___: bad

easy :___:___:___:___:___:___:___: difficult

efficient :___:___:___:___:___:___:___: inefficient

satisfactory :___:___:___:___:___:___:___: unsatisfactory

To me, this factor is

important :___:___:___:___:___:___:___: unimportant

25	Relevancy of output information (to intended function)

useful :___:___:___:___:___:___:___: useless

relevant :___:___:___:___:___:___:___: irrelevant

clear :___:___:___:___:___:___:___: hazy

good :___:___:___:___:___:___:___: bad

satisfactory :___:___:___:___:___:___:___: unsatisfactory

To me, this factor is

important :___:___:___:___:___:___:___: unimportant

26	Volume of output information

concise :___:___:___:___:___:___:___: redundant

sufficient :___:___:___:___:___:___:___: insufficient

necessary :___:___:___:___:___:___:___: unnecessary

reasonable :___:___:___:___:___:___:___: unreasonable

satisfactory :___:___:___:___:___:___:___: unsatisfactory

To me, this factor is

important :___:___:___:___:___:___:___: unimportant

27	Personal job effects resulting from the computer-based support

liberating :__:__:__:__:__:__:__: inhibiting

significant :__:__:__:__:__:__:__: insignificant

good :__:__:__:__:__:__:__: bad

valuable :__:__:__:__:__:__:__: worthless

satisfactory :__:__:__:__:__:__:__: unsatisfactory

To me, this factor is

important :__:__:__:__:__:__:__: unimportant

28	Accuracy of output information

accurate :__:__:__:__:__:__:__: inaccurate

high :__:__:__:__:__:__:__: low

consistent :__:__:__:__:__:__:__: inconsistent

sufficient :__:__:__:__:__:__:__: insufficient

satisfactory :__:__:__:__:__:__:__: unsatisfactory

To me, this factor is

important :__:__:__:__:__:__:__: unimportant

29	Precision of output information

sufficient :___:___:___:___:___:___:___: insufficient

consistent :___:___:___:___:___:___:___: inconsistent

high :___:___:___:___:___:___:___: low

definite :___:___:___:___:___:___:___: uncertain

satisfactory :___:___:___:___:___:___:___: unsatisfactory

To me, this factor is

important :___:___:___:___:___:___:___: unimportant

30	Communication with the EDP staff

harmonious :___:___:___:___:___:___:___: dissonant

productive :___:___:___:___:___:___:___: destructive

precise :___:___:___:___:___:___:___: vague

meaningful :___:___:___:___:___:___:___: meaningless

satisfactory :___:___:___:___:___:___:___: unsatisfactory

To me, this factor is

important :___:___:___:___:___:___:___: unimportant

31	Organizational position of the EDP function

appropriate :___:___:___:___:___:___:___: inappropriate

strong :___:___:___:___:___:___:___: weak

clear :___:___:___:___:___:___:___: hazy

progressive :___:___:___:___:___:___:___: regressive

satisfactory :___:___:___:___:___:___:___: unsatisfactory

To me, this factor is

important :___:___:___:___:___:___:___: unimportant

32	Time required for new systems development

short :___:___:___:___:___:___:___: long

dependable :___:___:___:___:___:___:___: urdependable

reasonable :___:___:___:___:___:___:___: unreasonable

acceptable :___:___:___:___:___:___:___: unacceptable

satisfactory :___:___:___:___:___:___:___: unsatisfactory

To me, this factor is

important :___:___:___:___:___:___:___: unimportant

33	Personal control of EDP service received

high :___:___:___:___:___:___:___: low

sufficient :___:___:___:___:___:___:___: insufficient

precise :___:___:___:___:___:___:___: vague

strong :___:___:___:___:___:___:___: weak

satisfactory :___:___:___:___:___:___:___: unsatisfactory

To me, this factor is

important :___:___:___:___:___:___:___: unimportant

34	Schedule of recurring output products and services

good :___:___:___:___:___:___:___: bad

regular :___:___:___:___:___:___:___: irregular

reasonable :___:___:___:___:___:___:___: unreasonable

acceptable :___:___:___:___:___:___:___: unacceptable

satisfactory :___:___:___:___:___:___:___: unsatisfactory

To me, this factor is

important :___:___:___:___:___:___:___: unimportant

35	Documentation

clear :__:__:__:__:__:__:__: hazy

available :__:__:__:__:__:__:__: unavailable

complete :__:__:__:__:__:__:__: incomplete

current :__:__:__:__:__:__:__: obsolete

satisfactory :__:__:__:__:__:__:__: unsatisfactory

To me, this factor is

important :__:__:__:__:__:__:__: unimportant

36	Completeness of the output information

complete :__:__:__:__:__:__:__: incomplete

consistent :__:__:__:__:__:__:__: inconsistent

sufficient :__:__:__:__:__:__:__: insufficient

adequate :__:__:__:__:__:__:__: inadequate

satisfactory :__:__:__:__:__:__:__: unsatisfactory

To me, this factor is

important :__:__:__:__:__:__:__: unimportant

37	Technical competence of the EDP staff

current :___:___:___:___:___:___:___: obsolete

sufficient :___:___:___:___:___:___:___: insufficient

superior :___:___:___:___:___:___:___: inferior

high :___:___:___:___:___:___:___: low

satisfactory :___:___:___:___:___:___:___: unsatisfactory

To me, this factor is

important :___:___:___:___:___:___:___: unimportant

38	Flexibility of systems

flexible :___:___:___:___:___:___:___: rigid

versatile :___:___:___:___:___:___:___: limited

sufficient :___:___:___:___:___:___:___: insufficient

high :___:___:___:___:___:___:___: low

satisfactory :___:___:___:___:___:___:___: unsatisfactory

To me, this factor is

important :___:___:___:___:___:___:___: unimportant

39	Integration (automated sharing of information) of system data bases

complete :___:___:___:___:___:___:___: incomplete

sufficient :___:___:___:___:___:___:___: insufficient

successful :___:___:___:___:___:___:___: unsuccessful

good :___:___:___:___:___:___:___: bad

satisfactory :___:___:___:___:___:___:___: unsatisfactory

To me, this factor is

important :___:___:___:___:___:___:___: unimportant

COMMENTS

Appendix 4.2

INSTRUCTIONS FOR ADJECTIVE PAIR SELECTION

The selection of the adjective pairs for factor scales was based on a two-phase Delphi type procedure. The following instructions and forms for both phases were completed by five university professors.

SELECTION OF BIPOLAR ADJECTIVE PAIRS

FOR SEMANTIC DIFFERENTIAL SCALES

AD-A046 549 AIR FORCE INST OF TECH WRIGHT-PATTERSON AFB OHIO F/G 9/2

MEASUREMENT OF COMPUTER USER SATISFACTION.(U)

AUG 77 S W PEARSON

UNCLASSIFIED AFIT-CI-78-1 NL

4 OF 4

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PURPOSE: The purpose of this exercise is the selection of bipolar adjective pairs which may be used to evaluate each concept that is listed. Each concept is related to a particular aspect of the computer-based information products and services provided to a user within an organization.

PROCEDURE: The adjective pairs that are selected for each concept should be highly germane to that individual aspect with a clear polarity of "goodness" or "badness". There is absolutely no limit to the number of times that an adjective pair may be selected for different concepts. The list of adjective pairs that have been used in other studies are provided only as a guide. Any adjective pair that you deem germane for evaluating a concept may be selected. Most adjectives can be negatively paired by the use of prefixes such as "un-", "in-", "dis-", etc. The steps to be followed are:

1. Read the list of adjective pairs to familiarize yourself with words that have been selected in other studies.
2. For each concept listed, select or formulate FOUR bipolar adjective pairs which are indicative of evaluation for that concept.
3. Write the selected adjective pairs in the spaces provided for each concept. If the pair is a duplicate of a pair listed in the guide, the associated number may be written into the space. An example is shown below:

CONCEPT

1	32
just-unjust*	timely-late**

*This pair is not listed in the guide
**This pair is an altered form of 4 and 34

4. This exercise is completed when selections have been made for each of the concepts listed.

SEQUEL: The adjective pairs selected for each concept by every individual respondent will be assembled. These groupings will be redistributed for a second, more confined, judgment. At that time, you will be asked to select the top four adjective pairs that may be used to evaluate the concepts. This sequel step should be much less time consuming than the initial selection process. Your cooperation is gratefully appreciated.

ADJECTIVE PAIRS USED IN OTHER SEMANTIC DIFFERENTIAL STUDIES

1. good - bad
2. optimistic - pessimistic
3. complete - incomplete
4. timely - untimely
5. sociable - unsociable
6. kind - cruel
7. harmonious - dissonant
8. selfish - unselfish
9. willing - unwilling
10. superior - inferior
11. sufficient - insufficient
12. voluntary - compulsory
13. assenting - dissenting
14. skilled - bungling
15. successful - unsuccessful
16. high - low
17. meaningful - meaningless
18. lucid - obscure
19. important - trivial
20. useful- useless
21. progressive - regressive
22. true - false
23. positive - negative
24. candid - deceitful
25. wise - foolish
26. strong - weak
27. concise - diffuse
28. fast - slow
29. complex - simple
30. stable - unstable
31. cautious - rash
32. loyal - disloyal
33. courteous - discourteous
34. early - late
35. interesting - boring
36. eager - indifferent
37. destructive - productive
38. consistent - inconsistent
39. regular - irregular
40. chaotic - ordered
41. clear - hazy
42. concentrated - diffuse
43. definite - uncertain
44. emotional - rational
45. expensive - cheap
46. fair - unfair
47. pleasant - unpleasant
48. powerful - weak
49. vague - precise
50. valuable - worthless

CONCEPTS

Relationship with the EDP staff

____________________ ____________________

____________________ ____________________

Processing of requests for changes to existing systems

____________________ ____________________

____________________ ____________________

Mode of interface (for input/output with the EDP center)

____________________ ____________________

____________________ ____________________

Organizational competition with the EDP unit

____________________ ____________________

____________________ ____________________

Confidence in systems

____________________ ____________________

____________________ ____________________

Timeliness of output information

____________________ ____________________

____________________ ____________________

Charge-back method of payment for services

Perceived utility (worth versus cost)

Vendor support of hardware and software

Language used to interact with systems

Expectations concerning computer-based support

Error recovery

Security of data

Degree of training

Understanding of systems

Feeling of participation

Currency of output information

Attitude of the EDP staff

Reliability of output information

Top management involvement

Format of output

______________________ ______________________

______________________ ______________________

Response/turnaround time

______________________ ______________________

______________________ ______________________

Priorities determination for EDP resource allocation

______________________ ______________________

______________________ ______________________

Convenience of access (to utilize the computer capability)

______________________ ______________________

______________________ ______________________

Relevancy of output information (to intended function)

______________________ ______________________

______________________ ______________________

Volume of output information

______________________ ______________________

______________________ ______________________

Job effects attributed to computer-based support

______________________ ______________________

______________________ ______________________

Accuracy of output information

Precision of output information

Communication with the EDP staff

Organizational position of the EDP function

Time required for new systems development

Feeling of control

Schedule of recurring output products and services

Documentation

____________________ ____________________

____________________ ____________________

Completeness of the output information

____________________ ____________________

____________________ ____________________

Technical competence of the EDP staff

____________________ ____________________

____________________ ____________________

Flexibility of systems

____________________ ____________________

____________________ ____________________

Integration of systems

____________________ ____________________

____________________ ____________________

SELECTION OF BIPOLAR ADJECTIVE PAIRS

FOR SEMANTIC DIFFERENTIAL SCALES

SECOND PHASE

PURPOSE: The purpose of this exercise is to select a final set of bipolar adjective pairs that are germane to evaluating different aspects of the computer-based information products and services that are provided to a user. It is crucial that these adjective pairs be indicative of a "good" or "bad" state of each concept from the perspective of the user. In other words, if the "positive pole" of the adjective pair describes the concept, the user is more satisfied than if the "negative pole" describes the concept. The adjective pairs should not be selected to indicate how important the concept is to the user. Each adjective pair should be appropriate for evaluating the concept in a word completion format, such as, "The CONCEPT is (adjective)".

PROCEDURES: Each concept that is listed is followed by a set of bipolar adjective pairs that were formulated during the initial phase. The selection process is confined to this set of adjective pairs. The steps to be followed are:

1. For each concept listed, select the FOUR bipolar adjective PAIRS that are most indicative of evaluation for that concept.
2. Place an "X" to the immediate left of the selected adjective pairs.
3. For each adjective pair selected, place a "+" over the adjective that indicates the positive state of that concept for the user. The "+" indicates the positive direction of the adjective pair for that concept. An example is shown below:

CONCEPT

X good - bad	complete - incomplete
fair - unfair	X fast - slow
X clear - hazy	X superior - inferior

4. The exercise is completed when selections have been made for each of the concepts listed. Thank you very much for your cooperation.

CONCEPTS

Relationship with the EDP staff

harmonious - dissonant
productive - destructive
cooperative - competitive
pleasant - unpleasant
valuable - worthless
cooperative - uncooperative
professional - unprofessional
frequent - infrequent
superior - inferior
good - bad
friendly - unfriendly
cooperative - belligerent
helpful - bothersome
formal - informal
candid - deceitful

Processing of requests for changes to existing systems

fast - slow
complex - simple
chaotic - ordered
willing - unwilling
reasonable - unreasonable
good - bad
timely - untimely
eager - indifferent
rigid - flexible
difficult - easy
skilled - bungling
successful - unsuccessful
reliable - unreliable
timely - late
early - late

Mode of interface for input/output with the EDP center

convenient - inconvenient
appropriate - inappropriate
proper - improper
useful - useless
courteous - discourteous
efficient - inefficient
meaningful - meaningless
chaotic - ordered
frequent - infrequent
regular - irregular
good - bad
favorable - unfavorable
complete - incomplete
clear - hazy
pleasant - unpleasant
organized - disorganized
defined - undefined
complex - simple
enjoyable - unenjoyable

Organizational competition with the EDP unit

productive - destructive	positive - negative
friendly - unfriendly	fair - unfair
high - low	viscious - friendly
useful - destructive	harmonious - dissonant
strong - weak	good - bad
significant - insignificant	clear - hazy
emotional - rational	

Confidence in systems

high - low	stable - unstable
positive - negative	strong - weak
optimistic - pessimistic	definite - uncertain
emotional - rational	complete - incomplete
superior - inferior	good - bad
reserved - unreserved	

Timeliness of output information

timely - untimely	appropriate - unappropriate
consistent - inconsistent	good - bad
meaningful - meaningless	useful - useless
stable - unstable	fast - slow
reasonable - unreasonable	regular - irregular
early - late	punctual - tardy

Charge-back method of payment for services

just - unjust	clear - hazy
fair - unfair	regular - irregular
good - bad	proper - improper
progressive - regressive	destructive - productive
consistent - inconsistent	known - unknown
reasonable - unreasonable	meaningful - meaningless
voluntary - compulsory	expensive - cheap

Perceived utility (worth versus cost)

expensive - cheap
high - low
sufficient - insufficient
definite - uncertain
good - bad
clear - hazy
significant - insignificant
positive - negative
valuable - worthless
regular - irregular
superior - inferior
known - unknown
useful - useless

Vendor support of hardware and software

good - bad
skilled - bungling
strong - weak
eager - indifferent
reasonable - unreasonable
sufficient - insufficient
timely - untimely
superior - inferior
complete - incomplete
consistent - inconsistent
known - unknown

Language used to interact with systems

simple - complex
complete - incomplete
sufficient - insufficient
valuable - worthless
superior - inferior
known - unknown
difficult - easy
vague - precise
appropriate - inappropriate
good - bad
clear - hazy
powerful - weak
reasonable - unreasonable
easy-to-use - hard-to-use
compatible - incompatible
universal - variable

Expectations concerning computer-based support

contented - frustrated
pleased - displeased
successful - unsuccessful
stable - unstable
definite - uncertain
vague - precise
high - low
optimistic - pessimistic
useful - useless
chaotic - ordered
clear - hazy
emotional - rational

Error recovery

fast - slow
definite - uncertain
complete - incomplete
sufficient - insufficient
superior - inferior
frequent - infrequent
clear - hazy
skilled - bungling
good - bad
timely - untimely
known - unknown
complex - simple
expensive - cheap

Security of data

secure - unsecure
definite - uncertain
successful - unsuccessful
useful - useless
good - bad
consistent - inconsistent
vague - precise
complete - incomplete
strong - weak
high - low
stable - unstable
known - unknown
cautious - rash

Degree of training

complete - incomplete
high - low
valuable - worthless
sufficient - insufficient
skilled - bungling
regular - irregular
superior - inferior
complex - simple
strong - weak

Understanding of systems

high - low
complete - incomplete
sufficient - insufficient
chaotic - ordered
superior - inferior
clear - hazy
good - bad
voluntary - compulsory
hard - easy

Feeling of participation

active - passive
positive - negative
superior - inferior
strong - weak
sufficient - insufficient
reasonable - unreasonable
good - bad
vague - precise
complete - incomplete
encouraged - repelled
high - low
definite - uncertain
informed - uninformed
involved - uninvolved
voluntary - compulsory
valuable - worthless

Currency of output information

old - new
good - bad
high - low
adequate - inadequate
superior - inferior
timely - untimely
sufficient - insufficient
stable - unstable
reasonable - unreasonable
early - late

Attitude of the EDP staff

user-oriented - self-centered
willing - unwilling
sociable - unsociable
valuable - worthless
courteous - discourteous
friendly - unfriendly
cooperative - belligerent
positive - negative
emotional - rational
loyal - disloyal
eager - indifferent
harmonious - dissonant
destructive - productive
good - bad
helpful - bothersome
pleasant - unpleasant
assenting - dissenting

Reliability of output information

consistent - inconsistent
good - bad
valuable - worthless
superior - inferior
reasonable - unreasonable
complete - incomplete
high - low
stable - unstable
regular - irregular
sufficient - insufficient

Top management involvement

strong - weak
positive - negative
complete - incomplete
constructive - destructive
helpful - bothersome
good - bad
meaningful - meaningless
destructive - productive
progressive - regressive
consistent - inconsistent
successful - unsuccessful
proper - improper
certain - uncertain
voluntary - compulsory
significant - insignificant

Format of output

clear - hazy
good - bad
sufficient - insufficient
superior - inferior
readable - unreadable
ordered - chaotic
simple - complex
useful - useless
liked - hated
pleasant - unpleasant

Response/turnaround time

fast - slow
timely - untimely
regular - irregular
enough - insufficient
definite - uncertain
consistent - inconsistent
good - bad
early - late
reasonable - unreasonable

Priorities determination for EDP resource allocation

fair - unfair
just - unjust
proper - improper
successful - unsuccessful
consistent - inconsistent
good - bad
clear - hazy
political - apolitical
favorable - unfavorable
progressive - regressive
sufficient - insufficient
useful - useless
chaotic - ordered
known - unknown
vague - precise

Convenience of access (to utilize the computer capability)

convenient - inconvenient	difficult - easy
complete - incomplete	favorable - unfavorable
sufficient - insufficient	high - low
consistent - inconsistent	pleasant - unpleasant
superior - inferior	good - bad
known - unknown	efficient - inefficient
fast - slow	complex - simple
fair - unfair	

Relevancy of output information (to intended function)

complete - incomplete	relevant - irrelevant
superior - inferior	valuable - worthless
high - low	good - bad
useful - useless	sufficient - insufficient
clear - hazy	known - unknown
meaningful - meaningless	vague - precise
timely - untimely	destructive - productive

Volume of output information

redundant - concise	good - bad
necessary - unnecessary	sparse - sufficient
high - low	useful - useless
destructive - productive	valuable - worthless
sufficient - insufficient	reasonable - unreasonable
liked - hated	known - unknown
complete - incomplete	consistent - inconsistent
concentrated - diffuse	

Job effects attributed to computer-based support

positive - negative	valuable - worthless
inhibiting - liberating	destructive - productive
good - bad	sufficient - insufficient
successful - unsuccessful	useful - useless
significant - insignificant	interesting - boring
clear - hazy	

Accuracy of output information

accurate - inaccurate
consistent - inconsistent
high - low
known - unknown
sufficient - insufficient
good - bad
definite - uncertain
stable - unstable
reasonable - unreasonable
clear - hazy

Precision of output information

vague - precise
sufficient - insufficient
complete - incomplete
useful - useless
consistent - inconsistent
superior - inferior
[illegible]
[illegible]
high - low
definite - uncertain
known - unknown

Communication with the EDP staff

complete - incomplete
simple - complex
harmonious - dissonant
clear - hazy
courteous - discourteous
interesting - dull
vague - precise
lucid - obscure
successful - unsuccessful
good - bad
destructive - productive
pleasant - unpleasant
high - low
willing - unwilling
frequent - infrequent
meaningful - meaningless

Organizational position of the EDP function

appropriate - inappropriate
just - unjust
good - bad
high - low
clear - hazy
fair - unfair
strong - weak
positive - negative
progressive - regressive
superior - inferior
vague - precise
known - unknown
powerful - weak
definite - uncertain

Time required for new systems development

long - short
reasonable - unreasonable
high - low
definite - uncertain
fast - slow
known - unknown
voluntary - compulsory
dependable - undependable
good - bad
clear - hazy
vague - precise
early - late
acceptable - unacceptable

Feeling of control

high - low
complete - incomplete
definite - uncertain
vague - precise
defined - undefined
sufficient - insufficient
strong - weak
powerful - weak
chaotic - ordered
fair - unfair

Schedule of recurring output products and services

timely - untimely
fair - unfair
good - bad
useful - useless
early - late
organized - disorganized
reasonable - unreasonable
sufficient - insufficient
chaotic - ordered
regular - irregular
skilled - bungling
destructive - productive
fast - slow
known - unknown
acceptable - unacceptable

Documentation

clear - hazy
complete - incomplete
proper - improper
timely - untimely
easy - hard
available - unavailable
useful - useless
current - obsolete
valuable - worthless
good - bad
meaningful - meaningless
accurate - inaccurate

Completeness of the output information

complete - incomplete
sufficient - insufficient
consistent - inconsistent
high - low
comprehensive - sparse
good - bad
adequate - inadequate
superior - inferior

Technical competence of the EDP staff

current - obsolete
skilled - bungling
consistent - inconsistent
strong - weak
known - unknown
sufficient - insufficient
superior - inferior
complete - incomplete
definite - uncertain
good - bad
high - low
powerful - weak

Flexibility of systems

flexible - rigid
good - bad
flexible - inflexible
clear - hazy
definite - uncertain
known - unknown
sufficient - insufficient
powerful - weak
versatile - limited
adept - clumsy
progressive - regressive
high - low
superior - inferior
reasonable - unreasonable
fair - unfair

Integration of systems

complete - incomplete
valuable - worthless
high - low
consistent - inconsistent
powerful - weak
known - unknown
superior - inferior
political - apolitical
productive - destructive
successful - unsuccessful
sufficient - insufficient
strong - weak
good - bad
useful - useless
vague - precise

Appendix 4.3

ADJECTIVE PAIR SELECTIONS

The following adjective pairs were selected to form the evaluation scales for the associated factors. The number of judges selecting the individual adjective pairs is shown in parentheses.

ADJECTIVE PAIR SELECTIONS

Relationship with the EDP staff
- harmonious - dissonant(5)
- cooperative-uncooperative(3)
- good - bad(2)
- candid - deceitful(2)

Processing of requests for changes to existing systems
- fast - slow(4)
- complex - simple(3)
- rigid - flexible(2)
- timely - untimely(2)

Mode of interface for input/output with the EDP center
- convenient - inconvenient(4)
- efficient - inefficient(2)
- clear - hazy(3)
- organized - disorganized(4)

Organizational competition with the EDP unit
- productive - destructive(3)
- high - low(3)
- harmonious - dissonant(4)
- emotional - rational(3)

Confidence in systems
- high - low(5)
- reserved - unreserved(2)
- strong - weak(3)
- good - bad(3)

Timeliness of output information
- timely - untimely(3)
- consistent - inconsistent(4)
- punctual - tardy(3)
- reasonable - unreasonable(2)

Charge-back method of payment for services
- just - unjust(3)
- consistent - inconsistent(3)
- known - unknown(3)
- reasonable - unreasonable(2)

Perceived utility (worth versus cost)
- high - low(3)
- sufficient - insufficient(2)
- positive - negative(3)
- useful - useless(2)

Vendor support of hardware and software
- skilled - bungling(3)
- eager - indifferent(3)
- consistent - inconsistent(3)
- sufficient - insufficient(3)

Language used to interact with systems
- simple - complex(4)
- difficult - easy(3)
- powerful - weak(2)
- easy-to-use - hard-to-use(4)

Expectations concerning computer-based support
- pleased - displeased(2)
- definite - uncertain(3)
- high - low(3)
- optimistic - pessimistic(3)

Error recovery	
fast - slow(3)	complex - simple(3)
complete - incomplete(2)	superior - inferior(2)
Security of data	
secure - unsecure(3)	complete - incomplete(2)
definite - uncertain(2)	good - bad(3)
Degree of training	
complete - incomplete(3)	superior - inferior(3)
high - low(3)	sufficient - insufficient(5)
Understanding of systems	
high - low(3)	hard - easy(4)
complete - incomplete(4)	sufficient - insufficient(5)
Feeling of participation	
positive - negative(3)	encouraged - repelled(4)
sufficient - insufficient(3)	involved - uninvolved(2)
Currency of output information	
good - bad(2)	timely - untimely(5)
adequate - inadequate(2)	reasonable - unreasonable(3)
Attitude of the EDP staff	
user-oriented - self-centered(5)	courteous - discourteous(2)
cooperative - belligerent(4)	positive - negative(2)
Reliability of output information	
consistent - inconsistent(4)	high - low(3)
superior - inferior(2)	sufficient - insufficient(5)
Top management involvement	
strong - weak(3)	consistent - inconsistent(5)
significant - insignificant(2)	good - bad(2)
Format of output	
good - bad(2)	simple - complex(3)
readable - unreadable(5)	useful - useless(4)
Response/turnaround time	
fast - slow(4)	consistent - inconsistent(3)
reasonable - unreasonable(3)	good - bad(3)
Priorities determination for EDP resource allocation	
fair - unfair(5)	just - unjust(5)
consistent - inconsistent(4)	vague - precise(2)

Convenience of access (to utilize the computer capability)
- convenient - inconvenient(3)
- good - bad(2)
- difficult - easy(4)
- efficient - inefficient(3)

Relevancy of output information (to intended function)
- useful - useless(2)
- relevant - irrelevant(3)
- good - bad(2)
- clear - hazy(3)

Volume of output information
- redundant - concise(2)
- necessary - unnecessary(2)
- reasonable - unreasonable(3)
- sufficient - insufficient(5)

Job effects attributed to computer-based support
- inhibiting - liberating(2)
- significant - insignificant(3)
- valuable - worthless(5)
- good - bad(4)

Accuracy of output information
- accurate - inaccurate(3)
- sufficient - insufficient(4)
- consistent - inconsistent(4)
- high - low(4)

Precision of output information
- sufficient - insufficient(4)
- consistent - inconsistent(4)
- high - low(2)
- definite - uncertain(2)

Communication with the EDP staff
- harmonious - dissonant(4)
- destructive - productive(3)
- vague - precise(2)
- meaningful - meaningless(3)

Organizational position of the EDP function
- appropriate - inappropriate(5)
- progressive - regressive(2)
- clear - hazy(3)
- strong - weak(2)

Time required for new systems development
- long - short(2)
- reasonable - unreasonable(4)
- dependable - undependable(4)
- acceptable - unacceptable(4)

Feeling of control
- high - low(3)
- sufficient - insufficient(4)
- strong - weak(2)
- vague - precise(3)

Schedule of recurring output products and services
- regular - irregular(3)
- reasonable - unreasonable(4)
- good - bad(2)
- acceptable - unacceptable(3)

Documentation
- clear - hazy(4)
- complete - incomplete(4)
- current - obsolete(2)
- available - unavailable(3)

Completeness of the output information

complete - incomplete(3)	adequate - inadequate(4)
sufficient - insufficient(5)	consistent - inconsistent(2)

Technical competence of the EDP staff

current - obsolete(3)	superior - inferior(2)
sufficient - insufficient(4)	high - low(3)

Flexibility of systems

flexible - rigid(3)	high - low(2)
sufficient - insufficient(4)	versatile - limited(2)

Integration of systems

complete - incomplete(3)	successful - unsuccessful(3)
sufficient - insufficient(3)	good - bad(2)

Appendix 5.1

FORTRAN PROGRAM FOR DATA SUMMARIZATION

The following computer listing illustrates the program used to summarize the data from the completed measurement instruments. A constant of +4.0 was added to each of the seven response interval values to change the range of -3 to +3 to the range +1 to +7, thereby eliminating negative numbers during the input process. The program was written in the FORTRAN IV language and executed on a UNIVAC 1110. No attempt was made to optimize the program execution.

```
            DIMENSION IS(234),RS(39),WS(39),SS(39),SUB(2,40),IDD(40)
            DO 5 I = 1,40
            SUB(1,I) = 0.0
            SUB(2,I) = 0.0
     5      CONTINUE
            READ (5,100)N
   100      FORMAT(I2)
            DO 10 KNT = 1,N
            READ(5,101)ID,(IS(J),J=1,234)
   101      FORMAT(I2,78I1/2X,78I1/2X,78I1)
            IDD(KNT) = ID
            K = 1
            DO 20 I = 1,39
            RS(I) = IS(K)+IS(K+1)+IS(K+2)+IS(K+3)
            RS(I) = (RS(I)-16.0)/4.0
            SS(I) = IS(K+4)-6
            WS(I) = IS(K+5)
            WS(I) =  (WS(I)*.15)-.05
            WS(I) = WS(I)*RS(I)
            K=K+6
            WRITE(6,102)KNT,I,RS(I),SS(I),WS(I)
   102      FORMAT (1H ,I2,3X,I2,3(3X,F6.2))
    20      CONTINUE
            WRITE(1,103)ID,(RS(IK),IK=1,13)
            WRITE(1,103)ID,(RS(IK),IK=14,26)
            WRITE(1,103)ID,(RS(IK),IK=27,39)
            WRITE(1,103)ID,(SS(IK),IK=1,13)
            WRITE(1,103)ID,(SS(IK),IK=14,26)
            WRITE(1,103)ID,(SS(IK),IK=27,39)
            WRITE(1,103)ID,(WS(IK),IK=1,13)
            WRITE(1,103)ID,(WS(IK),IK=14,26)
            WRITE(1,103)ID,(WS(IK),IK=27,39)
   103      FORMAT(I2,13F6.2)
            DO 30 KK = 1,39
            SUB(1,KNT) = SUB(1,KNT)+RS(KK)
            SUB(2,KNT) = SUB(2,KNT) + WS(KK)
    30      CONTINUE
    10      CONTINUE
            WRITE(6,105)
   105      FORMAT(1H1,7HSUBJECT,7X,5HSCORE,7X,9HWTD SCORE)
            KEY =9999
            WRITE(1,106)KEY
   106      FORMAT(I4)
            DO 40 I= 1,N
            WRITE(6,104)IDD(I),SUB(1,I),SUB(2,I)
   104      FORMAT(1H ,I2,8X,F10.4,10X,F10.4)
            WRITE(1,107)IDD(I),SUB(1,I),SUB(2,I)
   107      FORMAT(I2,2F10.4)
    40      CONTINUE
            END
```

Appendix 5.2

FORTRAN PROGRAM FOR ANALYSIS OF VARIANCE

The following computer listing illustrates the program used to compute the analysis of variance and to calculate a reliability coefficient for each factor. The program also calculated the importance scale means and the scale means for the satisfied and dissatisfied user groups. The difference in means was calculated as the range. The item (scale) scores shown in the sample output include a constant of +4.0 which was added to eliminate negative numbers during the input process. The program was written in the FORTRAN IV language and executed on a UNIVAC 1110. No attempt was made to optimize the program execution.

```
      DIMENSION D(32,234),R(39),S(4),SUB(35),SAT(4),DIS(4)
      DO 5 I = 1,32
      DO 5 J = 1,234
      D(I,J) = 0.0
5     CONTINUE
      DO 6 I = 1,39
      R(I) = 0.0
6     CONTINUE
      READ (5,100)N
100   FORMAT(I2)
      DO 7 I = 1,N
      READ(5,101)ID,(D(I,J),J = 1,234)
101   FORMAT(I2,78F1.0/2X,78F1.0/2X,78F1.0)
7     CONTINUE
      K = 1
      DO 50 KNT = 1,39
      DO 9 I = 1,4
      S(I) = 0.0
      SAT(I) = 0.0
      DIS(I) = 0.0
9     CONTINUE
      DO 10 I = 1,N
      SUB(I) = 0.0
10    CONTINUE
      CT = 0.0
      TOT = 0.0
      XIN = 0.0
      KD = 0
      KS = 0
      WRITE (6,102)KNT
102   FORMAT(1H1,20X,7HFACTOR ,I2,12H RELIABILITY/
     1 1H ,20X,8HSUBJECTS,10X,5HITEMS,9X,6HTOTALS/
     2 1H ,32X,1H1,4X,1H2,4X,1H3,4X,1H4/1H ,1X )
      DO 20 I = 1,N
      SUB(I) = D(I,K)+D(I,K+1)+D(I,K+2)+D(I,K+3)
      XIN = XIN + D(I,K+5)
      WRITE(6,103)I,D(I,K),D(I,K+1),D(I,K+2),D(I,K+3),SUB(I)
103   FORMAT(1H ,23X,I2,5X,4F5.2,F7.2)
      S(1) = S(1) + D(I,K)
      S(2) = S(2) + D(I,K+1)
      S(3) = S(3) + D(I,K+2)
      S(4) = S(4) + D(I,K+3)
      CT = CT+D(I,K)**2. +D(I,K+1)**2. +D(I,K+2)**2. +D(I,K+3)**2.
      IF(SUB(I).LE.10.)GO TO 20
      IF(SUB(I).GT.15.)GO TO 19
      DIS(1) = DIS(1) + D(I,K)
      DIS(2) = DIS(2) + D(I,K+1)
      DIS(3) = DIS(3) + D(I,K+2)
      DIS(4) = DIS(4) + D(I,K+3)
      KD = KD +1
      GO TO 20
19    SAT(1) = SAT(1) + D(I,K)
      SAT(2) = SAT(2) + D(I,K+1)
      SAT(3) = SAT(3) + D(I,K+2)
      SAT(4) = SAT(4) + D(I,K+3)
      KS = KS +1
20    CONTINUE
      K = K + 6
      SSIT = 0.0
      SSID = 0.0
      DO 30 KK = 1,N
      TOT = TOT + SUB(KK)
      SSID = SSID + SUB(KK)**2.
30    CONTINUE
      DIV = N*4
      CF = (TOT**2.)/DIV
      SST = CT - CF
      DIV = N
      SSIT = (S(1)**2. +S(2)**2. +S(3)**2. +S(4)**2.)/DIV
      SSIT = SSIT - CF
      SSID = (SSID/4.) - CF
```

```
      SSE = SST - SSIT - SSID
      DFIT = 3
      DFID = N - 1
      DFTOT = (4*N) - 1
      DFER = DFTOT - DFIT - DFID
      SMIT = SSIT/DFIT
      SMID = SSID/DFID
      SMER = SSE/DFER
      WRITE(6,104)
104   FORMAT(1H ,1H )
      WRITE(6,105)(S(I),I=1,4)
105   FORMAT(1H ,20X,5HTOTAL,5X,4F5.0)
      WRITE(6,104)
      WRITE(6,104)
      WRITE(6,104)
      WRITE(6,115)
115   FORMAT(1H ,10X,6HSOURCE,8X,2HSS,8X,2HDF,7X,2HMS)
      WRITE(6,104)
      WRITE(6,106)SST,DFTOT
106   FORMAT(1H ,10X,5HTOTAL,7X,2F10.2)
      WRITE(6,107)SSIT,DFIT,SMIT
107   FORMAT(1H ,10X,5HITEMS,5X,3F10.2)
      WRITE(6,108)SSID, DFID, SMID
108   FORMAT(1H ,10X,8HSUBJECTS,2X,3F10.2)
      WRITE(6,109)SSE, DFER,SMER
109   FORMAT(1H ,10X,5HERROR,5X,3F10.2)
      WRITE(6,104)
      WRITE(6,104)
      REL = 1.0 - (SMER/SMID)
      XN = N
      XIM = XIM / XN
      WRITE(6,110)REL,XIM
110   FORMAT(1H ,10X,14HRELIABILITY = ,F5.4,10X,16HIMPORTANCE MEAN =
     1 F5.2)
      WRITE(6,104)
      WRITE(6,112)KS,KD
112   FORMAT(1H ,10X,11HSCALE MEANS,5X,10HSATISFIED ,I2,2X,
     1 13HDISSATISFIED ,I2,3X,5HRANGE)
      WRITE(6,104)
      DO 49 I = 1,4
      SAT(I) = SAT(I) / KS
      DIS(I) = DIS(I) / KD
      RAN = SAT(I) - DIS(I)
      WRITE(6,113)I,SAT(I),DIS(I),RAN
113   FORMAT(1H ,15X,I2,11X,F5.2,10X,F5.2,10X,F5.2)
49    CONTINUE
50    CONTINUE
      END
```

Appendix 5.3

SAMPLE FACTOR ANALYSIS OUTPUT

The following computer listing illustrates a sample output from the SPSS package programs for factor analysis. The program was executed on a UNIVAC 1110. The variables labeled V001, V002, V003, and V004 correspond to the four factor one scale values, respectively. These values include a constant of +4.0 which was added to eliminate negative numbers during the input process.

SAMPLE OUTPUT

RELIABILITY

FACTOR 1 RELIABILITY

SUBJECTS	ITEMS 1	2	3	4	TOTALS
1	7.00	7.00	7.00	7.00	28.00
2	4.00	7.00	5.00	5.00	21.00
3	6.00	6.00	7.00	7.00	26.00
4	7.00	7.00	6.00	6.00	26.00
5	7.00	7.00	7.00	7.00	28.00
6	7.00	7.00	7.00	7.00	28.00
7	6.00	6.00	6.00	6.00	24.00
8	5.00	5.00	6.00	5.00	21.00
9	3.00	3.00	2.00	2.00	10.00
10	5.00	7.00	7.00	4.00	23.00
11	4.00	4.00	5.00	4.00	17.00
TOTAL	61.	66.	65.	60.	

SOURCE	SS	DF	MS
TOTAL	92.75	43.00	
ITEMS	2.36	3.00	.79
SUBJECTS	78.75	10.00	7.87
ERROR	13.64	30.00	.45

RELIABILITY = .940[illegible] IMPORTANCE MEAN = 6.27

SCALE MEANS	SATISFIED 10	DISSATISFIED 1	RANGE
1	5.80	3.00	2.80
2	6.30	3.00	3.30
3	6.30	2.00	4.30
4	5.30	2.00	3.30

VARIABLE	MEAN	STANDARD DEV	CASES
V001	5.3448	1.3168	29
V002	5.5517	1.2417	29
V003	5.2414	1.4307	29
V004	4.9310	1.3870	29

CORRELATION COEFFICIENTS..

	V001	V002	V003	V004
V001	1.00000	.92791	.67463	.77613
V002	.92791	1.00000	.74662	.74869
V003	.67463	.74662	1.00000	.76464
V004	.77613	.74869	.76464	1.00000

DETERMINANT = .0174656(.17465600-01)

INVERSE OF CORRELATION MATRIX..

	V001	V002	V003	V004
V001	8.71407	-7.43834	1.41570	-2.27670
V002	-7.43834	9.07829	-2.35261	.77514
V003	1.41570	-2.35261	3.11744	-1.72108
V004	-2.27670	.77514	-1.72108	3.50266

VARIABLE	EST COMMUNALITY
V001	.88524
V002	.88985
V003	.67922
V004	.71450

FACTOR	EIGENVALUE	PCT OF VAR	CUM PCT
1	3.32209	83.1	83.1
2	.38229	9.6	92.6
3	.23778	5.9	98.6
4	.05784	1.4	100.0

CONVERGENCE REQUIRED 6 ITERATIONS

FACTOR MATRIX USING PRINCIPAL FACTOR WITH ITERATIONS

	FACTOR 1
V001	-.91903
V002	-.94239
V003	-.80261
V004	-.85500

VARIABLE	COMMUNALITY
V001	.84461
V002	.88811
V003	.64419
V004	.73102

FACTOR	EIGENVALUE	PCT OF VAR	CUM PCT
1	3.10792	100.0	100.0

NUMBER OF FACTORS LE 1 ROTATION MAKES NO SENSE
PROCESSING CONTINUES BYPASSING ROTATION

FACTOR SCORE COEFFICIENTS

	FACTOR 1
V001	-.18831
V002	-.49380
V003	-.11455
V004	-.25155

Appendix 5.4

SELECTION OF CLASSIFIED USERS

PURPOSE: The purpose of this exercise is to identify middle management users of computer-based information products and servcies who may be classified as either (1) extremely satisfied, (2) extremely dissatisfied, or (3) slightly satisfied or dissatisfied with the computer-based support that they now receive in their present job position. These three groups will be used to test the validity of a measurement instrument designed to measure user satisfaction.

PROCEDURE: The following procedures should be followed in making the user identifications. The classifications should reflect how the users feel about the support that they receive; not how you feel about their support.

1. List the middle management users whom:
   (a) you know well.
   (b) you are confident of their feelings of satisfaction or dissatisfaction.
   (c) you consider amenable to participation in this research (time required : 20 - 25 minutes).

2. List those names in the appropriate classification section of the attached data sheets.

3. Complete the additional information indicated on the data sheets.

4. (Optional) Call the individuals and personally ask them to participate in the research project. Indicate to them that they will be contacted by Sammy Pearson within two days to complete a questionnaire.

5. If an individual declines to participate, remove the name from the list.

6. List at least six names (more is preferable) in each of the three classifications.

7. Return the completed data sheets to either Dr. James Bailey or Sammy Pearson.

Thank you very much for your cooperation.

Data Sheet

EXTREMELY SATISFIED USERS

	name	company	phone #	contacted (yes/no)
1.				
2.				
3.				
4.				
5.				
6.				

SLIGHTLY SATISFIED OR DISSATISFIED USERS

	name	company	phone #	contacted (yes/no)
1.				
2.				
3.				
4.				
5.				
6.				

EXTREMELY DISSATISFIED USERS

	name	company	phone #	contacted (yes/no)
1.				
2.				
3.				
4.				
5.				
6.				

Appendix 5.5

FACTOR-DIMENSION MATRIX

The following computer listing illustrates the complete factor loading from a SPSS factor analysis of the 29 subject responses to the measurement instruments. The variables, identified as R01 to R39, correspond to the user satisfaction factors shown in Appendix 3.8.

FILE NONAME (CREATION DATE = 27 MAY 76)

VARIMAX ROTATED FACTOR MATRIX

	FACTOR 1	FACTOR 2	FACTOR 3	FACTOR 4	FACTOR 5	FACTOR 6	FACTOR 7	FACTOR 8
R01 +	.81617	.08339	.04379	.30963	-.01636	.17461	.14566	.11029
R02	[illegible]	.23077	.37843	.25471	-.13329	.63393	.08323	-.06242
R03	.21759	.44054	.33993	.12048	.35551	.35876	.11883	-.00756
R04	.28878	-.11432	[illegible]	.26188	.07399	.07788	.32630	-.08963
R05 −	.42064	.49909	.28768	[illegible]	.15380	.36235	.47436	.10288
R06	.03859	.21846	.16093	[illegible]	.24352	.20631	.24861	-.09575
R07	.30539	-.06905	.00507	.06342	-.22044	-.01477	.09526	.71843
R08 +	[illegible]	.27557	-.04792	.05058	.12347	.23594	.18094	.26954
R09	.32247	.41854	.09079	.08838	.20015	.53741	.36277	.23948
R10	-.17551	.22703	[illegible]	.35538	.10045	.37283	-.08036	.25305
R11 +	.61249	.28664	.14073	.16142	.25724	.37774	.37434	.22003
R12	.26637	.49773	.43612	.18363	.18213	.37936	.09461	.02144
R13	.02266	.45396	.25124	-.02232	.32966	.04901	.00825	[illegible]
R14	.17648	.32569	.74376	-.00499	.06345	.33813	.00957	.18936
R15	.20882	.41209	.36883	.17422	.37849	.49942	.24877	.18235
R16 +	.56605	.15454	.06307	.20640	.20549	.49783	.03763	.36103
R17	.07748	.34685	.03943	.72099	.22558	.00447	.03400	.15567
R18 +	[illegible]	.33220	.36130	.18014	.03723	.11469	.23200	.03637
R19	.20227	[illegible]	.07157	.17843	-.05516	.19247	.11003	.08936
R20	.24625	.17591	.15437	.03528	.05254	.78777	-.00428	-.11241
R21	.09970	.79872	.29508	-.13076	.40922	.13323	.20981	.12813
R22	.29178	[illegible]	.42286	.34461	.18702	.34290	.05931	.08690
R23	.27975	.47495	.30286	.32210	.34435	.36734	.00533	-.14090
R24	.28025	.53815	.24790	.25348	.01016	.34505	.49400	-.11049
R25	.23278	.35756	.10723	.14439	.25045	-.04528	.64925	.11728
R26	.02552	.00249	.05170	.31917	.75415	.02285	.17688	-.08881
R27	.25091	[illegible]	.14043	.10336	-.25100	.44674	.31650	.21461
R28	.19708	[illegible]	.15072	.29214	.15815	.01311	.21092	.03712
R29	.31608	.74503	.01344	.35330	.03981	.31625	.18169	.04385
R30 +	[illegible]	.24070	.33401	.04331	.09849	.16048	-.02167	-.11840
R31	-.04972	.25581	.39342	.13911	.42587	.47726	.07603	.25638
R32 −	.37381	.24782	.39046	.23892	-.05059	.55574	.28232	.13286
R33	.34615	.29121	.40478	.64428	-.05592	.33861	.08488	-.02067
R34	.40433	.49562	.17060	.13735	.07996	.28468	-.10479	.19351
R35	.20496	.42860	.40662	-.05450	.11712	.49392	.36327	.23414
R36	.16830	[illegible]	.19343	.26333	-.01615	.19795	.12739	-.04826
R37	.85124	.19228	.11161	-.16643	-.13030	.08643	.15305	.06887
R38	.27045	.21964	.29194	.33306	.12516	.50143	.52521	-.00868
R39 −	.37296	.31786	.49759	.06029	.18732	.29637	.39973	.08474

BIOGRAPHICAL SKETCH

Sammy Wray Pearson was born in Fort Worth, Texas, on July 7, 1945. He graduated from Calvert High School in Calvert, Texas, in 1963. He then attended Texas A&M University and graduated with a Bachelor of Arts degree in Mathematics in 1967. He continued at Texas A&M and earned a Master of Science degree in Computer Science in 1970. Following commissioning in the United States Air Force, he first served as Chief of Data Automation in Karamursel AS, Turkey. In 1971, he joined the Air Force Data System Design Center as a computer systems analyst. He began his studies at Arizona State University in 1973. He is a member of the American Institute of Industrial Engineers and Alpha Pi Mu, the Industrial Engineering honor society. He is married to the former Barbara Emily Olsen of Stratford, Connecticut.